STOPPING WATER POLLUTION AT ITS SOURCE

MISA

Municipal/Industrial Strategy for Abatement

INVENTORY AND COSTING OF BEST AVAILABLE POLLUTION CONTROL TECHNOLOGIES FOR THE IRON AND STEEL SECTOR IN ONTARIO

Ontario

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INVENTORY AND COSTING OF BEST AVAILABLE POLLUTION CONTROL TECHNOLOGIES FOR THE IRON AND STEEL SECTOR IN ONTARIO

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Foreword

The Ontario Ministry of Environment and Energy retained Hatch Associates to develop a database of technical design, operating, performance and cost for the available pollution control technologies, in-plant controls and best management practices of each process subcategory of the Iron and Steel Sector.

This report includes assessment of five Best Available Technology (BAT) models:

1. Best in Ontario
2. Best in U.S.A.
3. Best at selected world locations (North America, Germany, Japan and South Korea)
4. Technology train that produces non-lethal effluent
5. Technology train that achieves virtual elimination of persistent toxic pollutants

The capital cost and operating & maintenance cost to apply each BAT model to Ontario plants were developed.

During the preparation of this report, some data essential for the development of effluent limits (i.e. process flows, cooling water flows and performance levels) were not available. These data were collected during the development of effluent limits.

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EXECUTIVE SUMMARY

Background and Objectives

The Municipal-Industrial Strategy for Abatement (MISA) is an Ontario Ministry of the Environment (MOE) initiative to abate wastewater discharges in Ontario. The ultimate goal is the virtual elimination of persistent toxic contaminants. The program involves direct dischargers to receiving waters: the municipalities and nine major industrial sectors (petroleum refining, organic chemical manufacturing, metal mining and refining, pulp and paper, inorganic chemical manufacturing, metal casting, electric power, industrial minerals, and iron and steel manufacturing). The first two phases of the program are the characterization of effluents and the development of regulations which will limit contaminant concentrations and discharge quantities. It is intended to base the regulations on Best Available (Pollution Control) Technology, Economically Achievable (BATEA).

After completion of the first phase for the Iron and Steel Sector, the MOE contracted Hatch Associates Ltd. (HA) to:

- develop an inventory of Best Available Technology (BAT) which could be used for water pollution control in Ontario Iron and Steel Mills; and

- develop approximate capital and operating costs to retrofit BAT systems in Ontario mills.

The results of this work, which was started in January, 1991, are outlined in this Executive Summary.

Ontario Steel Sector

The general magnitude of the study can be appreciated by reference to the nature of Ontario's Primary Steel Industry. Statistics Canada data shows that this industry accounted for 7.3 per cent of the value added and 6.9 per cent of production workers employed in provincial manufacturing in 1986. The data also show that approximately 28,000 men and women were employed in the Primary Steel Industry in Ontario in 1986. The integrated and non-integrated steel mills, which comprise most of this sector and are the focus of this study, rank second only behind the motor vehicle industry in Ontario in terms of value added, contributing $2.3 billion per year to the provincial economy.

There are seven iron and steel mills in Ontario which fall under the MISA initiative for direct dischargers in the Iron and Steel Industry. These include four integrated mills and three non-integrated mills (Specialty and Mini Mills). Other steel operations discharge wastewater to Publicly Owned Treatment Works (POTW's) which will be subject to monitoring at a later date. Discharges to municipal treatment plants are presently regulated by Municipal Sewer By-Laws.

The integrated mills are The Algoma Steel Corporation, Limited (Algoma); Dofasco Inc., (Dofasco); Stelco Inc., Hilton Works (Stelco Hilton); and Stelco Inc., Lake Erie Works (Stelco LEW).

The non-integrated mills are Atlas Specialty Steels (Atlas); IVACO Rolling Mills (IVACO); and the Lake Ontario Steel Company (LASCO).

Table I entitled *Iron and Steel Mills Under the MISA Program* lists the location, major products, 1987 steelmaking production, approximate wastewater discharge flowrate and the wastewater discharge location for each mill.

TABLE 1: IRON AND STEEL MILLS UNDER THE MISA PROGRAM

COMPANY	LOCATION	MAJOR STEEL PRODUCTS	1987 STEELMAKING CAPACITY (million tonnes)	TOTAL WATER DISCHARGE* (m3/day)	DISCHARGE LOCATION
The Algoma Steel Corporation, Limited	Sault Ste. Marie	plate, sheet, strip, seamless pipe & tube, structural shape & rails	3	800 000	St. Mary's River
Atlas Specialty Steel	Welland	stainless, carbon, low and high alloy: tool, machinery and mining steels	0.2	15 000	Welland Canal
Dofasco Inc.	Hamilton	flat and cold rolled, galvanized, galvalume, tinplate and silicon electrical steel	4	870 000	Hamilton Harbour, Lake Ontario
Ivaco Rolling Mills	L'Orignal	low and medium carbon: billets, wire rod	0.5	5 000	Ottawa River via Mill Creek
Lake Ontario Steel Company	Whitby	low carbon grade bars & alloy round bars	0.66	6 800	Lake Ontario
Stelco Inc., Hilton Works	Hamilton	low to high carbon: flat & cold rolled, galvanized, tin plate, bar and rod	3	875 000	Hamilton Harbour, Lake Ontario
Stelco Inc., Lake Erie Works	Nanticoke	hot rolled carbon for outside sale and for finishing at Hilton Works	2	40 000	Lake Erie via Centre Creek

*Based on Final MISA Monitoring Data, and may include process wastewater, non-contact cooling water or stormwater, where monitored.

Files MILLSUM.WK1 and MILLSUM.ALL

Methodology

BAT options are evaluated and selected for several common production units at the integrated mills. These are:

- Cokemaking;
- Sintering;
- Ironmaking;
- Steelmaking;
- Continuous Casting;
- Hot Forming; and
- Finishing.

BAT's for another category, referred to as Integrated Mills, where process water is cascaded from one unit operation to another, are also evaluated. This category is divided into two sections: Integrated Mills-Excluding Finishing and Integrated Mills-Including Finishing. It is believed that this approach might be more practical for existing integrated mills with central water treatment facilities.

Non-integrated Mills are evaluated for two categories:

- Mini Mills; and
- Specialty Mills.

Best Management Practices (BMP) are recommended for three additional categories. The best operating practices in the USA and Ontario for these categories were chosen as BMP. These categories are:

- utilities;
- non-contact cooling water (NCCW); and
- stormwater.

A major part of the study is the identification of a range of BAT options which could be applied to each category of the Ontario Iron and Steel Sector. Thus, the following options are evaluated for each of the categories noted above:

- BAT #1 Best in Ontario
- BAT #2 Best in USA
- BAT #3 Best at Selected World Locations
- BAT #4 Non-Lethal (Passes Ontario Toxicity Test)
- BAT #5 Virtual Elimination of Persistent Toxics

The BAT for each of the first three classifications is the one which is judged capable of producing the lowest pollutant loadings, and for which sufficient technical and cost data is available for proper evaluation. For the purpose of this study, virtual elimination is considered to require zero discharge of point source wastewaters with minimum or no inter-media transfer, wherever a process category effluent is known to contain persistent toxics.

The main criterion to determine and assess BAT's is demonstrated effectiveness. A technology is considered to be demonstrated (available) if:

- it has been used by the steel industry or in a similar application in another industry for an extended period, at more than one location; and
- sufficient technical, pollutant loading and cost information is available to enable a proper evaluation of its effectiveness and economic achievability.

The initial screening of BAT considered the following technical issues:
- changes in production process
- chemical substitution
- in-plant controls
- best management practices
- water conservation

- effluent treatment technologies
- energy conservation.

The merits of all of the above approaches are discussed. Emphasis is placed on water conservation and effluent treatment technologies because there is plentiful reliable technical and cost information available for these. For the same reason BAT trains are evaluated, as opposed to unit operations.

In addition, the approaches of Pollution Prevention and Multi-Media are evaluated and discussed. Multi-Media concepts are used to evaluate those aspects of technologies related to potential cross-media and inter-media transfers. Pollution Prevention refers to all pollution reduction methods, except end-of-pipe treatment. As noted above, most of the effort in this study focuses on effluent treatment because these technologies are proven and are well documented. However, process changes are discussed and promoted as potentially more cost effective than end-of-pipe solutions.

Information Sources

The main sources of information used to select and characterize BAT's are:

- Ontario Mill Initial Reports;
- MISA Program Effluent Data;
- Environment Canada Treatment Facilities Performance Evaluation Studies;
- the results of a technical literature review;
- the response to a questionnaire sent to each Ontario Iron and Steel mill; and
- information collected on visits to mills in Ontario, the United States of America (USA), and at selected world locations. (Holland, Germany, Japan and Korea).

Most of the reliable data is from wastewater treatment systems in Ontario and the USA. This is because complete and reliable effluent monitoring and reporting requirements are legislated and operating in these jurisdictions. Extensive information from the USA is found in the Environmental Protection Agency (EPA) Development Documents. US mill operating data is obtained from the US EPA, National Pollutant Discharge Elimination System (NPDES) which requires monthly reporting of effluent data as part of the compliance programs. Ontario Mill data is obtained from the MISA monitoring data. Relevant data is also available directly from 13 mills in the USA.

Data on the performance of treatment systems at the USA mills was provided by G.A. Amendola, a sub-consultant to the project.

Large, recently constructed steelworks in Japan and South Korea have relatively new pollution control systems. Data is available from HA's visits to two of these plants - NKK's Keihin Works in Japan and POSCO's Kwangyang Works in South Korea. Information is also used from HA's visits to the Thyssen Steelworks in Germany and the Hoogovens Steelworks in Holland. Both have modernized wastewater treatment facilities. The information obtained during the overseas visits is not nearly as extensive as that obtained from mills in Canada and the USA.

The information used in this study has been obtained from sources which we consider reliable. However, not all of the data has been subjected to audit. Nor should the data herein be used for setting effluent limits without careful and thorough review.

Parameter Selection

The relative merits of one available technology over another is based primarily on effluent loadings, expressed as grams of pollutant per tonne of production (from the production category). The demonstrated technology with the lowest effluent loadings is the Model BAT for the relevant category and geographical area (e.g. Ontario, USA).

The pollutants, or parameters, which are used to evaluate the effectiveness of BAT technologies are selected from the MISA Effluent Monitoring Data for the 12 month period starting November 1, 1989. Parameters with reported concentrations below a statistically determined level by the MOE are not included. The resulting list of 67 parameters is referred to as the Preliminary Selection List for BAT Evaluation. Nineteen incongruous (not typically present in iron and steel mill effluent) parameters are then excluded from this list. The resulting forty-eight parameters are then evaluated for their suitability for this study (that is, their usefulness in evaluating BAT technologies).

The criteria used for the selection of parameters (from the list of 48) to be used to evaluate BAT herein are:

- there is treatment performance data readily available in the iron and steel sector;
- the pollutant is known to be treatable with proven technology;
- the pollutant is known to be generated within the process;
- the pollutant is representative of a class of pollutants or the pollutant is indicative of the overall treatment effectiveness of the process.

The parameters selected on this basis are shown in Tables 2, 3, 4 and 5.

TABLE 2: SELECTION OF PARAMETERS FOR BAT EVALUATION

Iron and Steel Sector

total suspended solids (TSS)
oil and grease
ammonia + ammonium
cyanide total
phenolics (4AAP)
cadmium
chromium
hexavalent chromium
lead
nickel
zinc
benzene
benzo(a)pyrene
naphthalene
pH
toxicity

Files: OVER2.WK1 and OVER2.ALL

TABLE 3: SELECTION OF PARAMETERS FOR BAT EVALUATION

Integrated Mills

	Cokemkng	Sinter. & Iron.	BOF & C. Cast.	Hot Forming	Finish.	Int. Mills
total suspended solids (TSS)	x	x	x	x	x	x
oil and grease	x	x	x	x	x	x
ammonia + ammonium	x	x				x
cyanide total	x	x				x
phenolics (4AAP)	x	x				x
chromium					x	x
hexavalent chromium					x	x
lead		x	x		x	x
zinc		x	x		x	x
benzene	x					x
benzo(a)pyrene	x					x
naphthalene	x					x
pH	x	x	x	x	x	x
toxicity	x	x	x	x	x	x

Files: OVER1.WK1 and OVER2.ALL

TABLE 4: SELECTION OF PARAMETERS FOR BAT EVALUATION

Specialty Mills

total suspended solids (TSS)
oil and grease
cadmium
chromium
hexavalent chromium
lead
nickel
zinc
pH
toxicity

Files: OVER4.WK1 and OVER4.ALL

TABLE 5: SELECTION OF PARAMETERS FOR BAT EVALUATION

Mini Mills

total suspended solids (TSS)
oil and grease
lead
zinc
pH
toxicity

Files: OVER3.WK1 and OVER3.ALL

MODEL BAT's

The Model BAT's for the classifications BAT #1 to #3 are those found with the lowest effluent loadings. The loadings are expressed in grams of pollutant per tonne of product from the category, or from the Specialty mill, or from the Mini-mill. The general results of the assessment are shown in Table 6: *Summary of Model BAT Selection*.

The BAT #4 is defined as the treatment technology which produces a non-lethal effluent (ie. passes the Ontario Toxicity Test). Toxicity testing of final effluents was carried out as part of the MISA monitoring program and where possible this has been used in assessing whether the predicted BAT #3 effluent characteristics will result in a non-lethal effluent. Process category wastewaters are typically discharged to sewers which also convey non-contact cooling water, other process wastewaters and stormwater run-off to a common discharge to the receiving water. This is the point at which an effluent is tested for toxicity.

An assessment has been made of the toxicity of BAT #3 effluents for each production category based on (1) actual toxicity testing where available and (2) review of known single contaminant concentrations of lethality (LC50). An evaluation of whether these concentrations can be further reduced to below lethal levels by treatment technologies was also made.

Factors which make the prediction of toxicity difficult are as follows:

1) Un-ionized ammonia levels are a function of pH and temperature, which will be variable.
2) Cyanide is typically present in an iron complex which is stable, and reported as non-toxic in this form.
3) The concentration at which metals become toxic is a function of hardness of the water.
4) The synergistic effect of several compounds at sub-lethal concentrations is not known, except where specific streams have been tested.
5) The effect of high levels of dissolved solids due to high recycle rates is known to affect toxicity, but no data is available to predict the exact toxic concentration, except where specific streams have been tested.

The only reliable method of toxicity evaluation is by direct testing of the effluent. Moreover, the determination of a technology train that will produce a non-lethal effluent for each process category is:

1) Of limited value because such effluents are usually combined with other streams prior to discharge to the receiving water.
2) Very difficult because of the limitations outlined in the preceding paragraph.

The definition of BAT #5 is "Virtual Elimination of Persistent Toxics". The definition of "Virtual Elimination" has caused difficulty, and at this time remains unresolved.

However, there appears to be general consensus of the MISA Issue Resolution Committee that "virtual elimination" means

1) Concentration below Regulation Method Detection Limit (RMDL), or
2) Concentration below Provincial Water Quality Objective (PWQO), or
3a) For those persistent and bioaccumulative toxic compounds, (Table I of the Effluent Monitoring Priority Pollutant List) concentration below RMDL, and
3b) For other toxics, concentrations below PWQO.

The compounds which are found in Iron and Steel Mill effluents which are persistent toxics, are:

<u>Bioaccumulative</u> - polynuclear aromatic hydrocarbons (PAHs) - particularly benzo(a) pyrene, from the Coke Plant effluent; and nickel and antimony.

<u>Unknown Bioaccumulation</u> - cadmium, chromium, lead, selenium, aluminum, copper, and vanadium.

Our approach to determining a technology train that meets the requirement of "Virtual Elimination" has been to consider "zero discharge of point source wastewaters with minimum or no inter-media transfer, wherever a process category effluent is known to contain persistent toxics". This definition was presented to the Joint Technical Committee early in the project. The

technology to achieve this would involve ultrafiltration/ion exchange or evaporation, followed by recycle of treated water to the process. A combination of these technologies approaches zero discharge. However, this is not demonstrated in this industrial sector.

Dry gas cleaning is also recommended as a BAT #5 option for Sintering and for Steelmaking. However, the technology is not readily adaptable to existing facilities. A potential long term BAT #5 option for Cokemaking is the combination of Pulverized Coal Injection (to blast furnace tuyeres), and Non-Recovery (of chemicals) Cokemaking, producing no effluent.

The performance of the overall wastewater control systems at Stelco LEW can be considered as BAT #3 "Best in the World". The mill has a high recycle rate for direct contact cooling water and other process water. NCCW is also re-circulated in Cokemaking, Ironmaking, Steelmaking, and the power station. Process water blowdown streams from Continuous Casting, Hot Forming, and Steelmaking are clarified and filtered prior to discharge via Pond 4. Cokemaking and Ironmaking effluents are clarified, breakpoint chlorinated for ammonia reduction, alkaline chlorinated for cyanide reduction, and filtered prior to discharge via Pond 4.

Stelco LEW also controls the discharge of stormwater and groundwater.

In general, the BAT #3 Best at Selected World Locations for each process category is either BAT #1 Best in Ontario or BAT #2 Best in the USA. Selected effluent data for the sectors and categories for BAT #3 are shown in Table 7: *Effluent Data for BAT #3 Best in the World*. This information is indicative of the level of performance that can be achieved by operations which adopt the technologies used at those locations.

The long-term average discharges at Stelco LEW over the MISA monitoring period and the US EPA New Source Performance Standard (NSPS) limits are shown in Table 8: *Comparison of Stelco LEW and EPA NSPS Limits*.

Stelco LEW final effluent was tested for toxicity during the MISA monitoring period. Of the tests conducted, 12 out of 12 passed for Rainbow Trout, and 10 out of 12 for Daphnia Magna. The reasons for the two failures of the Daphnia Magna tests are not known. However, the overall results indicate that this effluent meets BAT #4 most of the time.

A careful review of the final effluent concentrations at Stelco LEW during the MISA monitoring period for the Blowdown Treatment Plant (MISA Pont 0400) indicates that the effluent may be considered to have met "Virtual Elimination" (BAT #5). Generally, concentrations of persistent toxics are at or below RMDL, with the exception of zinc. The cyanide is reported to be complexed with iron and probably not toxic. Zinc is below the minimum acute toxicity concentration established by MOE, and below the US EPA range (both depending on hardness). Zinc is a listed persistent toxic, not bioaccumulative.

No demonstrated technologies are known to further reduce the concentrations of these compounds in this industry sector.

The wastewater treatment provided at Stelco LEW's production process area (e.g. Cokemaking), combined with the further treatment provided at the Blowdown Treatment Plant, has resulted in the virtual elimination of persistent bioaccumulative toxics such as benzo-(a)-pyrene.

The Blowdown Treatment Plant effluent (MISA Point 0400) discharges to Pond 4 where it is mixed with NCCW and surface run-off. This provides a limited dilution effect of about 1.7:1 on average, which may assist the effluent in passing the Ontario Toxicity Test (for Rainbow Trout), at the final discharge point to Lake Erie (MISA Point 0100).

TABLE 6: SUMMARY OF MODEL BAT SELECTION

CATEGORY	BAT NO. 1 BEST IN ONTARIO	BAT NO. 2 BEST IN USA	BAT #3 BEST IN WORLD
COKEMAKING	STELCO LEW	INLAND STEEL, Indiana Harbor	STELCO LEW
SINTERING	---	US STEEL, Gary Indiana, or BETHLEHEM STEEL, Sparrows Point, or INLAND STEEL, Indiana Harbor	US STEEL, Gary Indiana, or BETHLEHEM STEEL, Sparrows Point, or INLAND STEEL, Indiana Harbor
IRONMAKING	STELCO LEW	INLAND STEEL, Indiana Harbor, or BETHLEHEM STEEL, Sparrows Point	STELCO LEW, or INLAND STEEL, Indiana Harbor
STEELMAKING	STELCO LEW (Note 1) OR STELCO Hilton (Note 2)	LTV STEEL, Cleveland (Note 1) or INLAND STEEL, Indiana Harbor (Note 3)	LTV STEEL, Cleveland (Note 1) or STELCO Hilton (Note 2)
CONTINUOUS CASTING	STELCO LEW	INLAND STEEL, Indiana Harbor	INLAND STEEL, Indiana Harbor
HOT FORMING	STELCO LEW	US STEEL, Gary Indiana	US STEEL, Gary Indiana
FINISHING	DOFASCO	NATIONAL STEEL, Midwest	NATIONAL STEEL, Midwest
INTEGRATED EXCL. FINISHING	STELCO LEW	NATIONAL STEEL GRANITE CITY – (Minus finishing – National Steel, Midwest)	STELCO LEW
SPECIALTY MILL	---	US STEEL, Gary Indiana – Hot Forming INLAND STEEL, Indiana Harbor – Cont. Casting MERCURY STAINLESS – Finishing	US STEEL, Gary Indiana – Hot Forming, and INLAND STEEL, Indiana Harbor – Cont. Casting, and MERCURY STAINLESS – Finishing
MINI MILLS	IVACO	NUCOR, Crawfordsville, Indiana	NUCOR, Crawfordsville, Indiana

Note 1: Suppressed combustion, wet scrubbing.
Note 2: Full combustion, dry gas cleaning.
Note 3: Full combustion, wet scrubbing.

Files: BATSUM.WK1 and BATSUM.ALL

TABLE 7: EFFLUENT DATA FOR MODEL BAT #3 – BEST IN THE WORLD

SECTOR:	INTEGRATED MILLS										NON - INTEGRATED		
CATEGORY:	Coke-making	3A Sintering (1)	3B Sintering (1)	Iron-making	3A BOF Stlmkg Supp. - Wet (2)	Cont. Casting	Hot Forming	Finishing	Int. Mill - Excl. Fin.	Int. Mill - Incl. Fin.	Specialty Mills Finishing	Specialty Mills HF & CC	Mini Mills
BAT #3 Mill:	Stelco LEW	USS,Gary	Beth., S.P.	Stelco LEW	LTV Cl.	Inland, IH	USS, Gary	Nat., Mld.	Stelco LEW		Mercury	BAT #2	
Flow (m3/tonne):	0.60	0.0091	0.46	0.80	0.0020	0.076	0.36	6.1	4.7		4.6	0.37	
POLLUTANT	(g/tonne)	(g/tonne)	(g/tonne)	(g/tonne)	(g/tonne)	(g/tonne)	(g/tonne)	(g/tonne)	(g/tonne)	see data	(g/tonne)	(g/tonne)	
TSS	4.4	0.12	4.0	3.9	0.0083	1.4	1.1	29	23	Stelco LEW	85	2.3	Nucor
oil and grease	0.86	0.12	2.7	-	-	0.16	2.3	14	6.5	(Int. Mill -	4.6	2.0	
ammonia/ammonium	0.10	0.77	28	0.41	-	-	-	-	0.39	Excl. Fin.)	-	-	(no
cyanide total	0.56	0.0019	0.064	0.37	-	-	-	-	0.53	+	-	-	effluent -
phenolics	0.0073	0.00011	0.038	0.0098	-	-	-	-	0.011	Nat. Mld.	-	-	used for
lead	-	0.0005	0.0087	0.018	0.000057	0.0087	-	-	0.15	(Fin.)	0.46	0.0087	slag
zinc	-	0.011	0.091	0.035	0.00036	0.0080	-	0.33	0.30		-	0.0080	evaporation
benzene	0.0031	-	-	-	-	-	-	-	0.0012		-	-	& electrode
benzo(a)pyrene	0.0062	-	-	-	-	-	-	-	0.0024		-	-	cooling)
naphthalene	0.0037	-	-	-	-	-	-	-	0.0014		-	-	
chromium	-	-	-	-	-	-	-	0.31	0.044		0.54	-	
chromium (VI+)	-	-	-	-	-	-	-	0.066	-		0.10	-	
cadmium	-	-	-	-	-	-	-	-	-		0.052	-	
nickel	-	-	-	-	-	-	-	-	-		1.0	-	

(1) Sintering BAT #3C – Inland Steel, IH. Dry gas cleaning.

(2) Steelmaking BAT #3B – Stelco Hilton, Open Combustion, Dry Gas Cleaning.

Files: SUMMODB3.WK1 and SUMMODB3.ALL

TABLE 8: COMPARISON OF STELCO LEW AND EPA NSPS LIMITS(1)

Parameter	Average Loading	
	Stelco LEW(2) (g/tonne)	EPA NSPS(1) (g/tonne)
TSS	23	66
oil and grease	6.5	1.0 – 19 (3)
ammonia and ammonium	0.39	9
total cyanide	0.53	1.7
phenolics	0.011	0.038
lead	0.15	0.20
zinc	0.30	0.30
benzene	0.0012	Max. 0.0128 (4)
benzo(a)pyrene	0.0024	Max. 0.0128 (4)
naphthalene	0.0014	Max. 0.0128 (4)
chromium	0.044	–
hex. chromium	–	–

(1) New Source Performance Standards, summation of EPA 40 CFR – Part 420, Subparts A,C,D,E,F,and G(c-1): Average of daily values for 30 consecutive days. All Cokemaking values have been multiplied by a factor of 0.4, as typically 400 kg of coke are required per raw tonne of steel (used elsewhere in this report). Actual coke/steel ratio at Stelco LEW during MISA monitoring period was 0.38. All Ironmaking values have been multiplied by 0.85 to reflect the amount of iron required per raw tonne of steel at Stelco LEW.

(2) From MISA Monitoring Point 0400.

(3) An average of daily values for 30 consecutive days for Oil and Grease is given for Continuous Casting only, and is 1.0 g/tonne. The maximum for any one day from Cokemaking(*0.4), Ironmaking(*0.85), Continuous Casting, and Hot Forming is 19 g/tonne.

(4) Maximum values for any 1 day, as average values are not published in 40 CFR – Part 420.

Files: LEW_NSPS.WK1 and LEW_NSPS.ALL

Applications of BAT

Approximate costs of applying Model BAT systems to the seven Ontario mills are shown in the tables:

- Table 9: *Integrated Mills Applied BAT #3 - Best in the World (Algoma, Dofasco, Stelco Hilton, Stelco Lew*; and
- Table 10: *Non-Integrated Mills Applied BAT #3 - Best in the World*.

The costs are preliminary budget estimates for use in assessing different options and selecting the preferred option. Prior to site commitment of investment funds, additional specific detailed engineering studies will be required.

The capital costs are direct costs, excluding working capital, construction interest and other extraordinary owner's costs. The two main costing procedures are (equipment) factored cost estimating and ratioed (plant) estimating. The accuracy is estimated to be generally about ±30 percent.

The tables also contain the approximate reduction in effluent flow that is likely to result from applying the Model BAT's. The effluent flow is a significant factor because, based on experience over several years, a decrease in effluent loadings can usually be best achieved by reducing effluent flow. Concentrations usually remain similar; thus, pollutant loadings decrease in proportion to the reduction in effluent flow (except cokemaking & finishing).

The BAT #3 classification is a good example to illustrate costs because its Model BAT's are, with one exception, the same as either BAT #1 or Bat #2. Thus, BAT #3 is illustrative of the best that can be achieved with well-established technology. (There is no substantially less stringent classification to consider because BAT #1 and BAT #2 are comparable in performance in most categories).

The applied BAT data provide estimates of pollutant loadings and approximate costs associated

with the installation of Model BAT systems. Additional development work, preliminary engineering and detailed engineering are required prior to the full evaluation and implementation of any of the technologies. The extent of this further work depends on the specific technology, complexity of chemistry, and the differences between the mill with the Model BAT and the mill being considered for its application. The latter factor can be significant and can cause uncertainties. Production technologies and product mix differ from one mill to another. Age and layout of mills also differ. In general, detailed studies and pilot tests are needed to assess the implication of high recycle rates and modification to water chemistry, such as water softening, at specific mills.

TABLE 9: INTEGRATED MILLS APPLIED BAT #3 – BEST IN THE WORLD

ALGOMA

CATEGORY	EFFLUENT FLOW		***ESTIMATED COST	
	Existing (m3/day)	Predicted (m3/day)	Capital (millions $)	Operating (millions $)
Cokemaking	1135*	1849	22.4	2.0
Ironmaking	51351	4988	21.9	3.2
BOF Steelmaking	15117	1530	6.2	1.3
Cont. Casting	no data available	411	30.7	7.4
Hot Forming	347065	2638		
Hot Forming – Tube Mills	2406	91	4.9	0.7
Finishing	no data available	6985	17.1	1.5
Int. Mills – Incl. Finishing	498400	36938	103.2	16.1

* Does not include coke quench wastewater.

DOFASCO

CATEGORY	EFFLUENT FLOW		***ESTIMATED COST	
	Existing (m3/day)	Predicted (m3/day)	Capital (millions $)	Operating (millions $)
Cokemaking	2818	2380	34.0	3.0
Ironmaking	1267*	6721	18.1	2.4
BOF Steelmaking	85229	1131	39.7	3.4
Cont. Casting & #2 Hot Mill	9267	2567	3.3	0.5
Hot Forming – #1 Hot Mill	71118	1514	20.4	1.7
Finishing	4875	4875	26.5	1.6
Int. Mill – Incl. Finishing	562341	52022	142.0	12.6

* Does not include wastewater from #2 Dekishing Station (ladle cleaning).

STELCO HILTON

CATEGORY	EFFLUENT FLOW		***ESTIMATED COST	
	Existing (m3/day)	Predicted (m3/day)	Capital (millions $)	Operating (millions $)
Cokemaking	no data available	1966	42.3	3.9
Sintering & Ironmaking	no data available	4700	24.2	3.4
BOF Steelmaking	no effluent	no effluent	0	0
Cont. Casting	no data available	346	74.5	11.4
Hot Forming	no data available	2335		
Hot Forming – #3 B & B Mill	180092	590	7.0	1.0
Hot Forming – No. 2 Rod Mill	27058	447	16.8	2.1
Finishing	no data available	21792	26.6	3.7
Int. Mill – Incl. Finishing	835715	50271	191.4	25.5

Note: Existing flows may include NCCW and/or stormwater.

Files: SUMMILLS.WK1 and SUMMILLS.ALL

TABLE 9: INTEGRATED MILLS APPLIED BAT #3 – BEST IN THE WORLD (Continued)

STELCO LEW

CATEGORY	EFFLUENT FLOW		***ESTIMATED COST	
	Existing (m3/day)	Predicted (m3/day)	Capital (millions $)	Operating (millions $)
Cokemaking	961	961	0	0
Ironmaking	2863	2863	0	0
BOF Steelmaking	4652	8.4	2.1	0.5
Cont. Casting	5745	320	2.6	0.5
Hot Forming	2863	1208	1.4	0.4
Int. Mill – Excl. Finishing	19607	19607	6.1	1.4

TABLE 10: NON–INTEGRATED MILLS APPLIED BAT #3 – BEST IN THE WORLD

CATEGORY:	EFFLUENT FLOW		***ESTIMATED COST	
	Existing (m3/day)	Predicted (m3/day)	Capital (millions $)	Operating (millions $)
Specialty Mills				
Atlas	15149	243	6.2	0.5
Mini Mills				
Ivaco	no effluent*	no effluent**	2.2	0.3
Lasco	6766	no effluent**	2.2	0.3

* Ivaco advise that they cannot maintain zero discharge at this time, and they intend to discharge an average of 0.26 m3/tonne, to a maximum of 1.0 m3/tonne.

** The BAT #3 mill discharges effluent on slag and electrodes.

*** Estimated Costs are based on rated production capacities.

Files: SUMMILLS.WK1 and SUMMILLS.ALL

Emerging Technologies

The long term goal of virtually eliminating persistent toxic compounds from wastewater can best be achieved by process changes, raw materials substitution and modified environmental control systems which do not use water or use substantially less water. One advantage of the emerging technologies is that they also bring productivity and other cost savings to an operation, particularly when a greenfield site or a major retrofit is being constructed.

For Integrated Mills, the Cokemaking process is of greatest concern, not only the aqueous discharges, but also the air emissions. Three promising options to further reduce or eliminate pollution are:

- Pulverised coal injection to blast furnace tuyeres, which can reduce coal consumption per tonne of pig iron by as much as 40 percent;

- Non-Recovery coking, whereby coke oven gas is combusted and energy is recovered in a co-generation system; gases would be cleaned by dry methods; recovery of chemicals would be eliminated and water use significantly reduced; NO_x and CO_2 emissions would increase;

- Direct Ironmaking and Steelmaking processes, which eliminate the need for coke by using coal directly, or natural gas; the Corex process, for example, is in commercial operation at Iscor Ltd.'s Pretoria Works in South Africa; another process, direct reduction of iron ore pellets, followed by electric furnace smelting to steel, is already well established in locations where natural gas is reasonably priced.

The growth of Mini Mills is continuing because of the increasing availability of scrap which is smelted in electric furnaces by these companies. This material would otherwise be landfilled. In Steelmaking, dry gas cleaning of fully combusted off-gas is well established. However, the

industry trend is toward recovering and cleaning the off-gas without combustion in order to use the energy elsewhere in the process. Such gases are now generally cleaned by wet scrubbing, but emerging dry cleaning technology might establish itself as a new standard in future years. It is also reported to use less energy for cleaning.

The emerging technologies tend to be more energy-efficient than the conventional systems and any inter-media transfers of pollutants tend to be minimal compared to the reduction of pollutant loadings in aqueous discharges which is achieved.

1.0 INTRODUCTION

1.1 The MISA Initiative

The Municipal Industrial Strategy for Abatement (MISA) is an Ontario Ministry of the Environment (MOE) initiative to improve the quality of water in Ontario. The program is described very well in the MOE information sheet "Backgrounder on MISA", parts of which are reprinted below:

> **"Overview**
>
> The Municipal Industrial Strategy for Abatement (MISA) is a major Ontario initiative to reduce water pollution from industrial and municipal dischargers. For the first time, Ontario will systematically cut back water pollution at its source with enforceable regulations that get tougher as abatement technology gets better. The ultimate goal is the virtual elimination of persistent toxic contaminants from all discharges into Ontario Waterways.
>
> Under MISA monitoring regulations, dischargers must measure the types, concentrations and total amounts of toxic substances present in their effluent. Audits by the ministry will ensure this information is accurate and reflects actual operating conditions in the plant. This information will be used to formulate an abatement regulation.
>
> An abatement regulation will place limits - based on the best available pollution control technology which is economically achievable (BATEA) - on toxic concentrations and total amounts for each discharger. This will be issued about two years after the monitoring regulation. Dischargers out of compliance with limits must take abatement actions. Both the limits and monitoring regulations are issued under Section 136 of the *Environmental Protection Act* (EPA).
>
> The MISA program initially will involve all major direct dischargers to Ontario's waterways: the municipalities and nine major industrial sectors - petroleum

refining, organic chemical manufacturing, iron and steel manufacturing, metal mining and refining, pulp and paper, inorganic chemical manufacturing, metal casting, electric power and industrial minerals.

Why MISA?

Public and scientific concern about water pollution has intensified and focused on persistent toxic contaminants. These complex pollutants are not being adequately removed by conventional wastewater treatment and constitute a long-term threat to drinking water, fisheries, and wildlife. They either never break down or do so only very slowly. As they accumulate in the environment, they are passed up the food chain in increasing amounts. Almost certainly, left unchecked, persistent toxic contaminants would have serious adverse effects on the people and environment of Ontario.

The MISA program will apply tough new measures to reduce toxic pollution, ensuring fair but stringent regulations are placed on dischargers:

- Monitoring regulations will require dischargers to identify and measure toxic substances in their effluent;
- Abatement regulations will reduce the concentrations and amounts of toxic substances that may be discharged;
- The limits will be determined by best available pollution control technology which is economically achievable (BATEA);
- Limits will be periodically tightened as technological improvements are achieved;
- Regulations will be applied on a sector-by-sector basis;

- Individual dischargers may be required to abate their pollution below the BATEA limits if the receiving body of water continues to be seriously degraded;

- Other industries, currently discharging into municipal sewer systems, will also be regulated under the sewer use control program;

- The ultimate goal of the program is the virtual elimination of persistent toxic substances from discharges to our waterways. **End of quote**"

1.2 Purpose of the Study

After completion of the MISA monitoring for the Iron and Steel Sector in Ontario, the MOE proceeded with the contracting of consultants to:

- develop an inventory of Best Available Technology (BAT) for water pollution control, and

- develop capital and operating costs to retrofit BAT systems in Ontario mills.

The study is best described by the following main objectives:

- develop an inventory of BAT's currently in use in steel mills in the United States of America (USA), Ontario, and in selected countries in Europe and Asia;

- select critical parameters to be used for the assessment of BAT treatability;

- evaluate and recommend BAT's from each of the above three jurisdictions that could be applied to Ontario's Iron and Steel mills;

- evaluate and recommend BAT's which would lead to non-toxic effluent; evaluate and recommend BAT's which would lead to the virtual elimination of toxic contaminants from the effluent;

- develop technical concepts, operating, performance, and order-of-magnitude capital and operating cost information for the above BAT's, referred to herein as "Model BAT's";

- establish the current status of water pollution control in Ontario's Iron and Steel Sector;

- determine means of applying each Model BAT to the appropriate process category in each Ontario mill, and predict the expected effluent quality.

- estimate the capital and operating costs of retrofitting or upgrading present mill facilities to Model BAT standards.

The purpose of the study was to develop technical and cost information to assist the setting of limits for effluent regulation in the Iron and Steel Sector. The complete terms of reference are included in Volume III-Appendix E.

1.3 The Approach Taken

The main parameter used to evaluate BAT's was demonstrated effectiveness. A technology was considered to be demonstrated (available) if:

- it had been used by the steel industry, or in a similar application in another industry, for an extended period, preferably at more than one location; and

- sufficient technical, pollutant loading and cost information were available to enable a proper evaluation of its effectiveness and economic achievability.

The relative merits of one available technology versus another were based primarily on effluent loadings, expressed as grams of pollutant per tonne of production. The available technology with the lowest effluent loadings was selected as BAT. The methodology for the selection of Model BAT's is described in more detail in Section 5.1.

The main consequence of the need for reliable data focused our search for BAT's primarily on wastewater treatment technologies in use in the USA and Ontario. This was because extensive effluent monitoring and reporting requirements are legislated and operating in these jurisdictions, and therefore actual performance could be substantiated.

Ontario's MISA monitoring program provided a database for the Ontario steel mills involved.

A program similar to MISA was completed by the Environmental Protection Agency (EPA) in the USA. Development Documents were produced for several industrial sectors, including Iron and Steel. These reports contain very extensive information regarding technologies which were used as a basis for new legislation which was first promulgated in 1982, and amended in 1984.

Relevant operating information available in the USA was acquired for this study by visiting 10 mills in the USA and obtaining data from these and three others.

Large, modern integrated steelworks were constructed in Japan starting in 1974 and in Korea starting in 1985. These facilities were reputed to have up-to-date pollution control systems and practices. Therefore, the best in each country was visited during the course of this project.

In addition, Germany and Holland had the reputation of having modern iron and steel plant wastewater treatment facilities. Therefore, a plant in each of these countries was visited.

The Ontario steel industry was classified into two principal sub-sectors, as follows:

- Integrated Mills
  - The Algoma Steel Corporation, Limited (Algoma)
  - Dofasco Inc. (Dofasco)
  - Stelco Inc., Hilton Works (Stelco Hilton)
  - Stelco Inc., Lake Erie Works (Stelco LEW)

- Non-Integrated Mills: Specialty Mills and Mini Mills
  - Atlas Specialty Steels (Atlas)
  - Ivaco Rolling Mills (Ivaco)
  - Lake Ontario Steel Company (Lasco)

Further, on the basis of the discrete production units at the integrated mills, the following major process categories were selected for developing BAT options.

- Cokemaking;
- Sintering;
- Ironmaking;
- Steelmaking;
- Continuous Casting;
- Hot Forming; and,
- Finishing.

In addition, a separate category, referred to as Integrated Mills, was also evaluated to address a central treatment approach. This category was divided into two sections: Integrated Mills - Excluding Finishing and Integrated Mills - Including Finishing. This category applies to existing integrated mills with central treatment facilities.

Vacuum Degassing was not selected as a process category for the following reasons:

- Vacuum Degassing is not practised at Algoma or Stelco Hilton;
- Vacuum Degassing is practised at Dofasco but on a small scale and there is not specific data available;
- The Vacuum Degassing wastewater at Stelco LEW is systematically integrated with Hot Forming, Steelmaking and Continuous Casting wastewater.

Water used in the above categories is referred to as process water. Non-contact cooling water and storm water are managed separately. They are not dealt with in detail in this study.

The objective of the study was to identify a range of BAT options which could be applied to treat process water in the Iron and Steel sector in Ontario. The following general options were evaluated for each process category:

BAT #1	Best in Ontario
BAT #2	Best in the USA
BAT #3	Best at Selected World Locations
BAT #4	Non-Lethal
BAT #5	Virtual Elimination of Persistent Toxics

A Non-Lethal effluent is one that passes the Ontario-Toxicity Test. Virtual Elimination, for the purposes of this study, is defined as zero aqueous discharge, with no or minimal inter-media transfer, wherever persistent toxic contaminants are present in the effluent.

The best systems were described as Model BAT's. Flowsheets and effluent data sheets were prepared for each Model BAT. The effluent data sheets give the following: average, maximum and minimum flows; average parameter loadings; average maximum and minimum parameter concentrations; parameter detection limits, number of samples tested and the number of samples less than the detection limit. In addition, the US EPA BAT flow (m^3/tonne) and the average parameter loadings (g/tonne) from the US EPA - 40 CFR are shown for comparison. The US EPA - 40 CFR loading values for TSS and oil are Best Practicable Technology (BPT)

limits and the loading values shown for all other parameters are Best Available Technology (BAT) limits.

In addition, summary data sheets for each sub-sector and each process category in the Integrated Mills sub-sector were generated. These data sheets are entitled Predicted Effluent Quality - - Generic. The production tonnes used in the calculations for production category emissions refer to the tonnes of production of the particular product during the MISA monitoring period. For example, coke production tonnes for coke plant effluent. For the Predicted Effluent Quality data sheets entitled Integrated Mills - Excluding Finishing and Integrated Mills - Including Finishing, the production tonnes of raw steel was used as the basis for calculation. The PEQ sheets show the effluent data for each Model BAT Option #1 - 5, including average flow (m^3/tonne), average concentration (mg/L) and average pollutant loading (g/tonne). The average flow (m^3/tonne) and average loading (g/tonne) were used to develop the Applied BAT Predicted Effluent Quality data sheets for each Ontario mill in Volume II. The data presented in the Predicted Effluent Quality -- Generic tables was rounded to two significant figures. These two significant figures were used in estimating the Applied BAT predicted effluent quality. Therefore, calculations based on the original data may not agree exactly due to rounding.

Capital and operating costs for each Model BAT option were developed.

Using the Model BAT treatment systems, the requirements for retrofitting Model BAT systems into Ontario mills were evaluated. Existing facilities were inspected and studied, and discussions of means of upgrading current processes were held with industry personnel. The new equipment and systems needed to bring the existing mills up to the Model BAT standards were referred to as Applied BAT's. For the Applied BAT options in each sub-sector and process category, schematic flow sheets were developed, the predicted effluent quality was calculated as described above, and estimated capital and operating costs to implement the technology were developed.

1.4 Costing Methodology

Two standard methods are mainly used to estimate the capital costs of the Model and Applied BAT's. These are an (equipment) factored estimate procedure and a ratioed (plant) estimate procedure. Most of the individual costs for the BAT options are determined by using a

combination of the two. In some cases order-of-magnitude estimates or allowances are made on a quick overview of requirements.

The prime basis of the factored estimates are budget prices (delivered) for the major process equipment shown on the flowsheets. These prices are from vendors, obtained specifically for this project, or from HA in-house files. The other items in the total direct plant cost are estimated as percentages of the delivered-equipment costs. The percentages or factors used are industry standards judged to be appropriate for this study.

The basis of each factored estimate is the equipment shown in the relevant flowsheet. The specific major retrofit requirements identified by industry are also included.

The ratioed estimate procedure relates the fixed capital investment for the facilities in question to the known fixed capital investment for a similar previously constructed plant. The costs for the BAT systems derived herein by this method were determined by multiplying the cost of the constructed facility by the ratio of the capacity of the new facility to the constructed facility, raised to the power 0.6. The Chemical Engineering Plant Cost indices is used to adjust previous year's prices to a 1991 basis. The exchange rate to convert USA to Canadian dollars, in 1990 is 1.18. A general cost factor of 1.15 is used to convert USA construction prices to Canadian.

The dissaggregated costs are determined by using the same percentages of total direct plant cost as are used for the factored estimates.

The basis of each ratioed estimate is the process system shown in the flowsheet. Specific major retrofit requirements, identified during visits to the mill, are also included. The Applied BAT costs are based on the actual production during the MISA monitoring period or the rated capacity, whichever is greater. The Annual Rated Production was divided by 334 days per year to obtain daily rated production which was then used to estimate flows to be treated.

An overall contingency of 25 percent is used for each estimate, to account for requirements which are generally not evident at this stage of a project.

Working capital, construction interest and other extraordinary owners' costs (such as research and development, major E.I.A. studies, etc.) are excluded.

It is our experience that this approach yields preliminary budget estimates. This type of estimate is not usually used as a basis for investment decisions. Rather, such costs are intended to assist in assessing options, or to assist in determining whether or not the next incremental phase in a project should be taken. A general overall accuracy of about ±30 percent is estimated.

The costs are based in HA's concepts of how systems should be retrofitted to achieve effluent loadings similar to the Model BAT's. It is expected that each company will have its own and likely different means of achieving these loadings. This is expected, but it is also expected that the resulting capital costs will be of the same order.

2.0 ONTARIO STEEL INDUSTRY SECTOR PROFILE

2.1 Introduction

There are seven iron and steel mills in Ontario which fall under the MISA Initiative for direct dischargers in the Iron and Steel Industry: four integrated mills, and three non-integrated mills (Specialty and Mini Mills). Other steel operations discharge wastewater to Publicly Owned Treatment Plants (POTW's) which will be subject to monitoring at a later date. Discharges to municipal treatment plants are presently regulated by Municipal Sewer By-Laws.

The integrated mills are The Algoma Steel Corporation, Limited (Algoma), Dofasco Inc. (Dofasco), Stelco Inc., Hilton Works (Stelco Hilton), and Stelco Inc., Lake Erie Works (Stelco LEW). The non-integrated mills are Atlas Specialty Steels (Atlas), Ivaco Rolling Mills (Ivaco) and the Lake Ontario Steel Company (Lasco). Table 2.1: *Iron and Steel Mills Under the MISA Program* lists the location, major products, 1987 steelmaking production, approximate wastewater discharge flowrate and the wastewater discharge location for each mill.

The primary steel industry is the sixth leading industrial group (of a total of 109) in Canada in terms of value added. Based on 1986 data, the industry accounted for 2.7% of the value added in Canadian manufacturing. (Statistics Canada (31-203) 1986). Additionally, the primary steel industry is the sixth leading sector in terms of providing manufacturing employment. In 1986, the sector provided just under 5.8% of Canada's manufacturing jobs.

The integrated and non-integrated steel mills constitute the predominant portion of this primary steel industry, contributing 94% of the total value added or $2.8 billion worth to the Canadian economy. These mills are thus ranked fifth out of several hundred industrial groupings found at this secondary level of Statistics Canada classifications.

On a provincial scale, the primary steel industry is even more important to the Ontario economy than it is to the national economy. In 1986, the industry accounted for 7.3% of the value added in provincial manufacturing, and 6.9% of production workers employed in manufacturing sectors. The integrated and non-integrated mills ranked second in terms of value added ($2.3 billion) behind the motor vehicle industry. Unlike the national economy whereby the two were fairly

equal, the iron and steel industry was far more important to the Ontario economy than was the non-ferrous smelting and refining industry.

The presence of the integrated and non-integrated steel mills is of crucial importance to the southern Ontario economy. It has strong links with this area's heavy concentration of automotive vehicle, parts and accessories industries. In Sault Ste. Marie the industry is a major component of the economy's export base. In total, approximately 28,000 men and women are employed in the primary steel industry in Ontario.

The following sections contain a brief description of each Ontario iron and steel mill, highlighting the wastewater treatment facilities. Further detail may be found in Volume III, Appendix A - Ontario Mill Visit Reports.

TABLE 2.1: IRON AND STEEL MILLS UNDER THE MISA PROGRAM

COMPANY	LOCATION	MAJOR STEEL PRODUCTS	1987 STEELMAKING CAPACITY (million tonnes)	TOTAL WATER DISCHARGE* (m3/day)	DISCHARGE LOCATION
The Algoma Steel Corporation, Limited	Sault Ste. Marie	plate, sheet, strip, seamless pipe & tube, structural shape & rails	3	800 000	St. Mary's River
Atlas Specialty Steel	Welland	stainless, carbon, low and high alloy: tool, machinery and mining steels	0.2	15 000	Welland Canal
Dofasco Inc.	Hamilton	flat and cold rolled, galvanized, galvalume, tinplate and silicon electrical steel	4	870 000	Hamilton Harbour, Lake Ontario
Ivaco Rolling Mills	L'Orignal	low and medium carbon: billets, wire rod	0.5	5 000	Ottawa River via Mill Creek
Lake Ontario Steel Company	Whitby	low carbon grade bars & alloy round bars	0.66	6 800	Lake Ontario
Stelco Inc., Hilton Works	Hamilton	low to high carbon: flat & cold rolled, galvanized, tin plate, bar and rod	3	875 000	Hamilton Harbour, Lake Ontario
Stelco Inc., Lake Erie Works	Nanticoke	hot rolled carbon for outside sale and for finishing at Hilton Works	2	40 000	Lake Erie via Centre Creek

*Based on Final MISA Monitoring Data, and may include process wastewater, non-contact cooling water or stormwater, where monitored.

Files MILLSUM.WK1 and MILLSUM.ALL

2.2 Integrated Mills

2.2.1 The Algoma Steel Corporation, Limited (Algoma)

Overview

Algoma is located in Sault Ste. Marie, Ontario. It was founded in 1901 in response to the demand for rail from the burgeoning USA and Canadian railroad systems. The company expanded its product range after its reorganization in 1935 and today is a fully integrated production facility. Its major products are steel plate, sheet and strip, seamless pipes and tubes, structural shapes and rails. In 1987, Algoma produced approximately 3 million tonnes of steel products.

The mill includes the following process operations: Cokemaking, Ironmaking, BOF Steelmaking, Continuous Casting and Finishing. Hot Forming Operations include a Blooming Mill, a Slabbing Mill, two Hot Strip Mills, a Rail and Structural Mill and two Tube Mills. Finishing Operations include Acid Pickling, a Reduction Mill and a Temper Mill.

Water is supplied to the mill from the St. Mary's River. The total wastewater discharge from the mill is approximately 800 000 m^3/day. This includes approximately 500 000 m^3/day treated process wastewater and 300 000 m^3/day non-contact cooling water (NCCW). In general, the treated wastewater discharges to the St. Mary's River through either the Bar and Strip Lagoon or the Main Filter Plant. Figure 2.1 shows the process wastewater discharge streams at Algoma.

Cokemaking

Once-through coke quenching wastewater is either routed to the Main Filter Plant for treatment or discharged. The Cokemaking By-Products Plant recovers anhydrous ammonia by the USS PHOSAM process and wastewater discharges to the Main Filter Plant.

Ironmaking

Once-through Ironmaking gas cleaning wastewater flows to the No. 2 thickener. Here polymer is added to assist settling before the thickener overflow is sent to the Bar and Strip Lagoon. Ironmaking NCCW is recycled to the process.

Steelmaking

Steelmaking gas cleaning wastewater flows via Thickener No. 1 to the Bar & Strip Lagoon. Once-through NCCW from No. 1 BOF discharges through the Main Filter Plant. NCCW is provided to the No. 2 BOF by recirculation from the slab caster mill.

Once through, contact cooling water from the No. 1 caster shop wastewater flows to the Bar and Strip Lagoon. Once through contact cooling water is conveyed to the Filter Plant.

Hot Forming

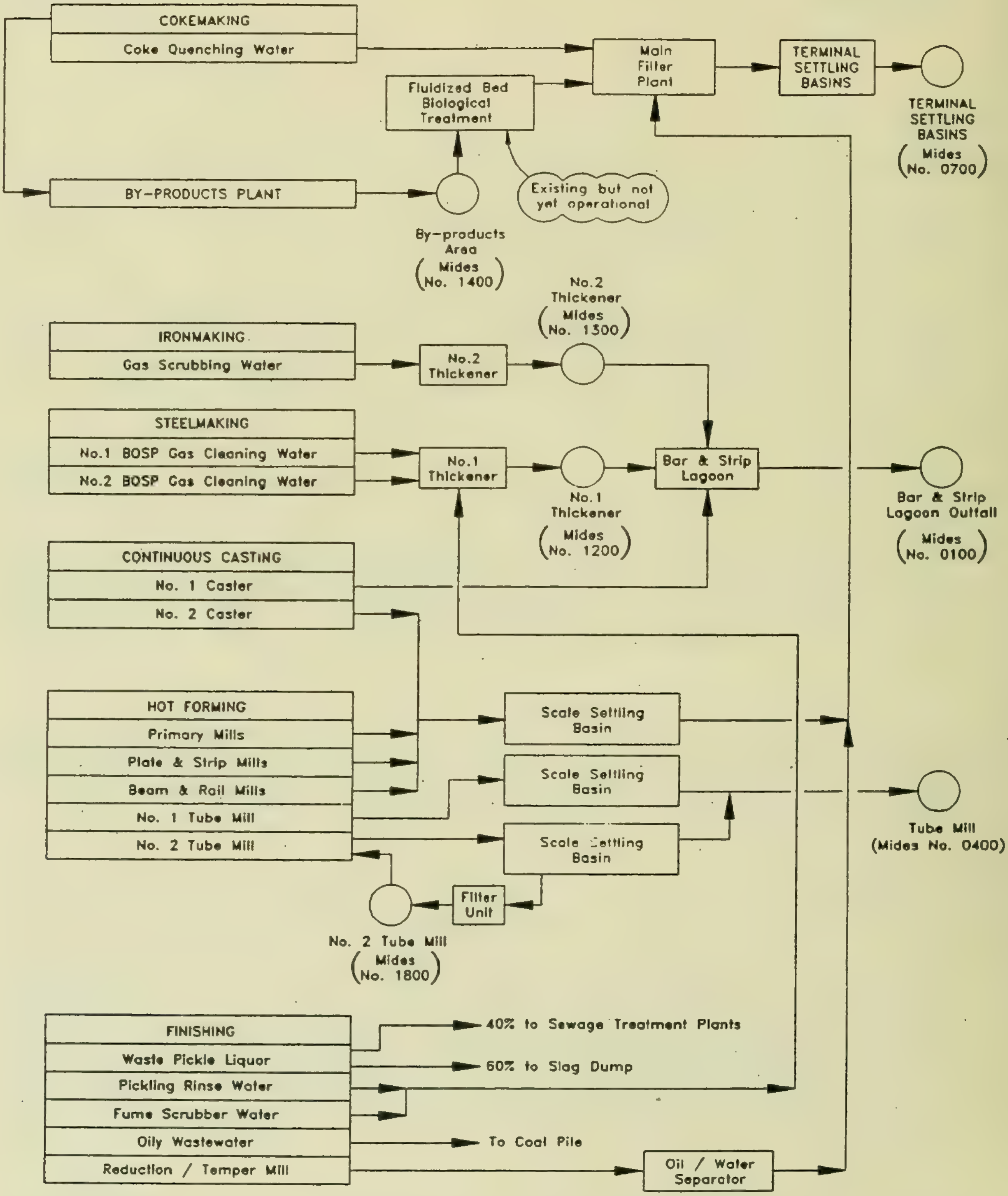
With the exception of the No. 2 Tube Mill, the Hot Forming Mills at Algoma have similar wastewater treatment systems. The reheat furnace cooling water is reused as contact cooling water on the strip. The contact water is then discharged to a scale pit. Overflow from the scale pit is occasionally recycled depending on the amount of oil in the water. From the scale pit wastewater flows to the Main Filter Plant.

The wastewater treatment system at the No. 2 Tube Mill includes a scale pit, pressure sand filters, and a cooling tower. The water is recycled to the mill. This water recycle and treatment system is comparable to the Best Available Technology for Ontario Mills.

Finishing

Waste pickle liquor is either sold to sewage treatment plants in Southern Ontario for reuse or disposed on the slag dump. Pickling rinse water and once-through fume scrubber wastewater are sent to the No. 1 thickener which discharges to the Bar and Strip Lagoon. Waste solutions from the reduction mill are sprayed on the coal pile. A soap solution used at the temper mill discharges to the basement. A sump in the basement collects all floor drains from the area and discharges wastewater to an external oil/water separator tank. From here the water fraction is conveyed to the Main Filter Plant.

The treatment process at the Main Filter Plant consists of a primary basin for removal of free oil followed by pressure filtration on sand filters. Oil is recovered from the filter backwash, and solids are allowed to settle out. The sludge is de-watered on a belt filter press.



HATCH ASSOCIATES

Figure 2.1 THE ALGOMA STEEL CORPORATION , LIMITED

PROCESS WASTEWATER DISCHARGE STREAMS

2.2.2 Dofasco Inc. (Dofasco)

Overview

Dofasco is located in Hamilton, Ontario and employs approximately 12 000 people. The mill produces approximately 4 million tonnes of steel products per year. These products include flat rolled, cold rolled, galvanized, galvalume, tinplate and silicon electrical steel.

The mill includes the following process operations: Cokemaking, Ironmaking, Steelmaking, Vacuum Degassing, Continuous Casting, Hot Forming and Finishing.

The sources of mill water are Hamilton Harbour and the City of Hamilton. Wastewater is eventually discharged to Hamilton Harbour at a rate of approximately 870 000 m^3/day, including 570 000 m^3/day treated process water and 300 000 m^3/day NCCW. Figure 2.2 shows the process wastewater discharge streams at Dofasco.

Cokemaking

Dofasco has three coke plants. Cokeside pushing emissions from the No.1 Coke Plant are cleaned with a wet electrostatic precipitator. The effluent from the wet electrostatic precipitators is directed to the No. 1 Coke Plant Quench Tower Sump. The No.2 Coke Plant uses a baghouse to clean its pushing emissions and does not have a water effluent. The No.3 Coke Plant uses a wet gas scrubber and directs its effluent to the quench tower sump and in turn to the quench tower. Cyanide is removed from the coke oven gas from all three coke plants in two Hydrogen Cyanide Plants. The #1 HCN plant removes cyanide as ammonium cyanide which is subsequently converted to ammonium sulphate and carbon dioxide using the Zimpro wet oxidation process. The #3 HCN Plant uses sodium carbonate to remove hydrogen cyanide. Spent liquor is blown down to a reductive burning recovery unit (RBR) which recovers the chemicals for reuse. Excess flushing liquor from the three coke plants is directed to the Flushing Liquor Ammonia Removal Plant (FLARP) consisting of two ammonia stills. Effluent from the Ammonia Stills is sent to an aerobic biological treatment plant prior to discharge.

Ironmaking

Dofasco has four Ironmaking Blast Furnaces. In the past, Ironmaking wastewater was treated and discharged directly to Hamilton Harbour. In April, 1990 a new blast furnace gas water recycling system was installed and by October, 1990 the system was fully operational. The system consists of a floc tank for polymer addition, a thickener, hot well, cooling tower, and a cold well. Effluent from the system is recycled to the Blast Furnaces and a blowdown stream is treated by a "Dynasand" sand filter prior to discharge to Hamilton Harbour. Effluent from the Ironmaking Ladle Cleaning Stations and De-Sulphurization Stations are treated in the BOF Thickener.

Steelmaking

There are two Steelmaking facilities at Dofasco. Gas cleaning wastewater from the #1 BOF Shop and No. 2 BOF Shop is treated in the BOF Thickener. Filtrate from the BOF sludge vacuum filter also goes to the BOF thickener.

Vacuum Degassing/Continuous Casting/Hot Forming

Dofasco has two hot strip mills. The No.1 Hot Strip Mill is ingot fed with a capacity of 3.1 million tonnes per year. The No.2 Hot Strip Mill is continuously cast slab fed with a capacity of 2.7 million tonnes per year. Wastewater from the No. 1 Hot Mill is treated in the No. 1 Hot Mill Water Filtration Plant. The plant has 14 gravity deep bed filters. Approximately 30% of the effluent is recycled to the No. 1 Hot Strip Mill and the remainder discharges to Hamilton Harbour. The No. 2 Hot Mill filtration plant treats the effluent from the No. 2 Hot Strip Mill, No. 1 Twin strand caster and the No. 4 BOF Vacuum Degasser. The filter plant consists of two settling basins followed by 17 gravity deep bed filters. The filter backwash is directed to a decant basin where the sludge is separated from the supernatant. The sludge is pumped to the BOF Thickener for treatment prior to discharge, while the supernatant is returned to the settling basins. The filtrate is cooled by forced draft cooling towers prior to recycling to the #2 Hot Strip Mill and the Caster. A bromine compound and sodium hypochlorite are added to the recycled water. Overall, a 98 percent recycle rate is achieved.

Finishing

Finishing operations at Dofasco include Acid Pickling, Cold Rolling, Alkaline Cleaning, Annealing, Galvanizing, Electrolytic Tinning, Tempering and Coating. There are three finishing plants at the Dofasco facility. These include the Main Plant, the Kenilworth Plant and the Bayfront Finishing Operations.

The Main Plant finishing facilities are as follows :

- No. 1, 2 and 3 Pickle Lines
- No. 1 and 2 Cleaning Lines
- No. 1 and 2 Tandem Cold Mills
- 4-56 Inch Cold Mill
- 1-66 Inch Cold Mill
- 42 Inch Temper Mill
- 56 Inch Temper Mill
- 1-66 Inch Temper Mill
- 2-66 Inch Temper Mill
- Batch Annealing Lines
- Open Coil Annealing Lines
- No. 2 Tower Anneal Line
- No. 1 and 2 Galvanizing Lines
- No. 2 and 3 Electrolytic Plating Lines

The wastewater from the Main Plant finishing operations, including oily wastewater, alkaline and acid rinses, is treated at the Cold Mill Wastewater Treatment Plant. The effluent from this facility is monitored at MISA MIDES #1000 before discharge to the Hamilton-Wentworth sewerage system. The Main Plant spent acid from the No. 1, 2 and 3 Pickle lines is regenerated at the No. 1 ARP. Wastewater from the No. 1 ARP tail gas scrubbers is currently discharged to the Hamilton-Wentworth sanitary sewer system after neutralization.

The Kenilworth Plant finishing operations include the No. 4 Pickle Line and the new Continuous Pickle Continuous Cold Mill Line which is under construction. The acid rinse from the No. 4

Pickle line is currently discharged to the sanitary sewer system. Spent acid from the No. 4 Pickle line is currently regenerated at the No. 2 ARP. Wastewater from the No. 2 ARP tail gas scrubbers is currently discharged to the Hamilton-Wentworth sanitary sewer system after neutralization. Dofasco plans to discharge acid rinses from the No. 4 Pickle line, tail gas scrubber effluent from the No. 2 ARP and acid rinses from the new Continuous Pickle Continuous Cold Mill Line to the Kenilworth Cold Mill Wastewater Treatment Plant, once construction of this facility is completed[1].

Finishing facilities are also located at the Bayfront Finishing Operations. This plant has the following finishing facilities:

- No. 3 Galvanizing Line
- No. 4 Galvanizing Line
- No. 5-56 Inch Cold Mill
- Magnesium Oxide Coating Line

The rinsewater and sump water from the No. 3 and No. 4 Galvanizing Lines is discharged directly to the sanitary sewer system. Spent high density cleaning solution from the No. 4 Galvanizing Line and the wastewater from the recoiler and payoff pits at the No. 3 and No. 4 Galvanizing Lines is collected and transported to the Main Plant Cold Mill Wastewater Treatment Plant. Waste rolling solution and washdown water from the No.5-56 Inch Cold Mill is also treated at the Main Plant Cold Mill Wastewater Treatment Plant. The wastewater from the Magnesium Oxide Coating Line is directed to the Magnesium Oxide Clarifier then discharged to the sanitary sewer system.

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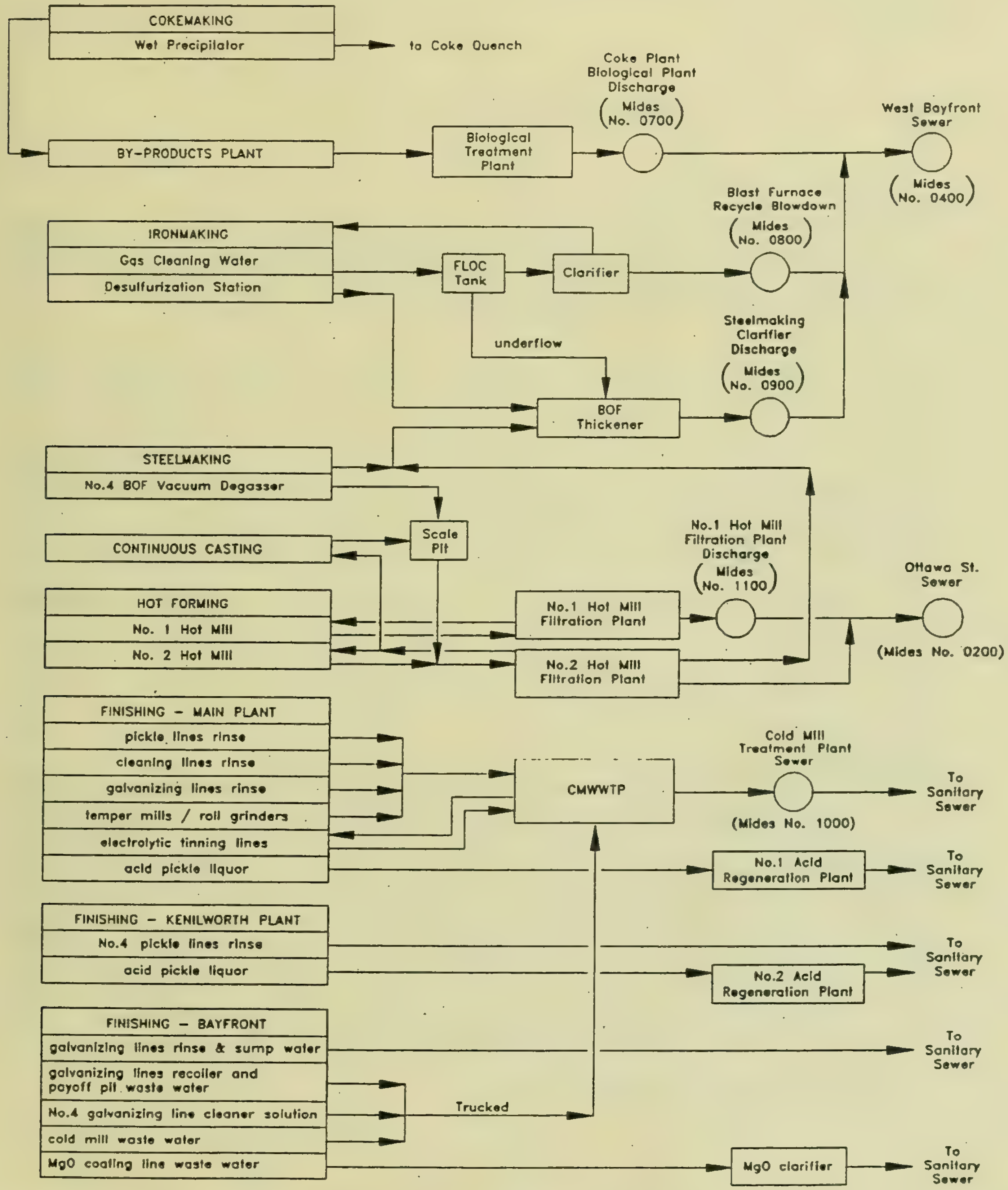
[1]As of January 1, 1992 these plans have been implemented.



HATCH ASSOCIATES

Figure 2.2 DOFASCO INC.

PROCESS WASTEWATER DISCHARGE STREAMS

2.2.3 Stelco Inc., Hilton Works (Stelco Hilton)

Overview

Stelco Hilton is located in Hamilton, Ontario. The mill produces approximately 3 million tonnes of steel products per year. These products include flat rolled, cold rolled, galvanized and tin plate, bar and rod shaped steel in a broad range of low to high carbon steel.

The mill consists of the following operations: Cokemaking, Sintering, Ironmaking, BOF Steelmaking, Continuous Casting, Hot Forming, and Finishing. The mill receives water from Hamilton Harbour and the city water supply. Treated wastewater and NCCW discharge from the mill to Hamilton Harbour through seven outfall locations at a total flowrate of approximately 875 000 m^3/day. Wastewater pre-treated in an Ammonia Still discharges under contract to the city sanitary sewer for final treatment at the Hamilton Wastewater Regional Sewage Treatment Plant, at a rate of approximately 1 400 m^3/day. The Steelmaking operations at Stelco Hilton use dry gas cleaning systems and therefore do not discharge a process wastewater stream. Figure 2.3 shows the process wastewater discharge streams at Stelco Hilton.

Cokemaking

There are three process wastewater streams from four operating Coke Oven Batteries at Stelco Hilton. Wet Electrostatic Precipitators clean the Coke Side Shed pushing emissions and the effluent flows to the East Side Filtration Plant (ESFP). Stack sump condensate and coke wharf drainage effluent discharge directly to Hamilton Harbour. Quench water recycles through the breeze basin and any breeze basin overflow discharges directly to Hamilton Harbour. The Coke Oven Batteries use small amount of NCCW on a once-through basis. The By-Products Plants produce two process wastewater streams. Effluent from the interceptor sumps flows to the ESFP and Ammonia Recovery Still effluent discharges to the sanitary sewer for treatment at the Regional Municipality Sewage Treatment Plant.

Sintering/Ironmaking

Sintering gas cleaning effluent is treated at the ESFP before discharge. Effluent from the Vacuum Filter Sludge Drying operation flows to Blast Furnace "E" Thickener. The Ironmaking facilities use a recirculated and cascaded wet gas cleaning system to cool and clean the BF gases for use as fuel elsewhere in the plant. Thickeners to remove solids and the effluent is cooled before recycle. A blowdown stream flows to the Sinter Plant scrubber for further use. Fresh water is used for cooling the slag. Slag cooling run-off water discharges directly to Hamilton Harbour.

Continuous Casting

Process water for Continuous Casting operations, cooling, descaling and flume flushing is partially recycled with a scale pit to remove solids and oil. The blowdown from the scale pit flows to the ESFP.

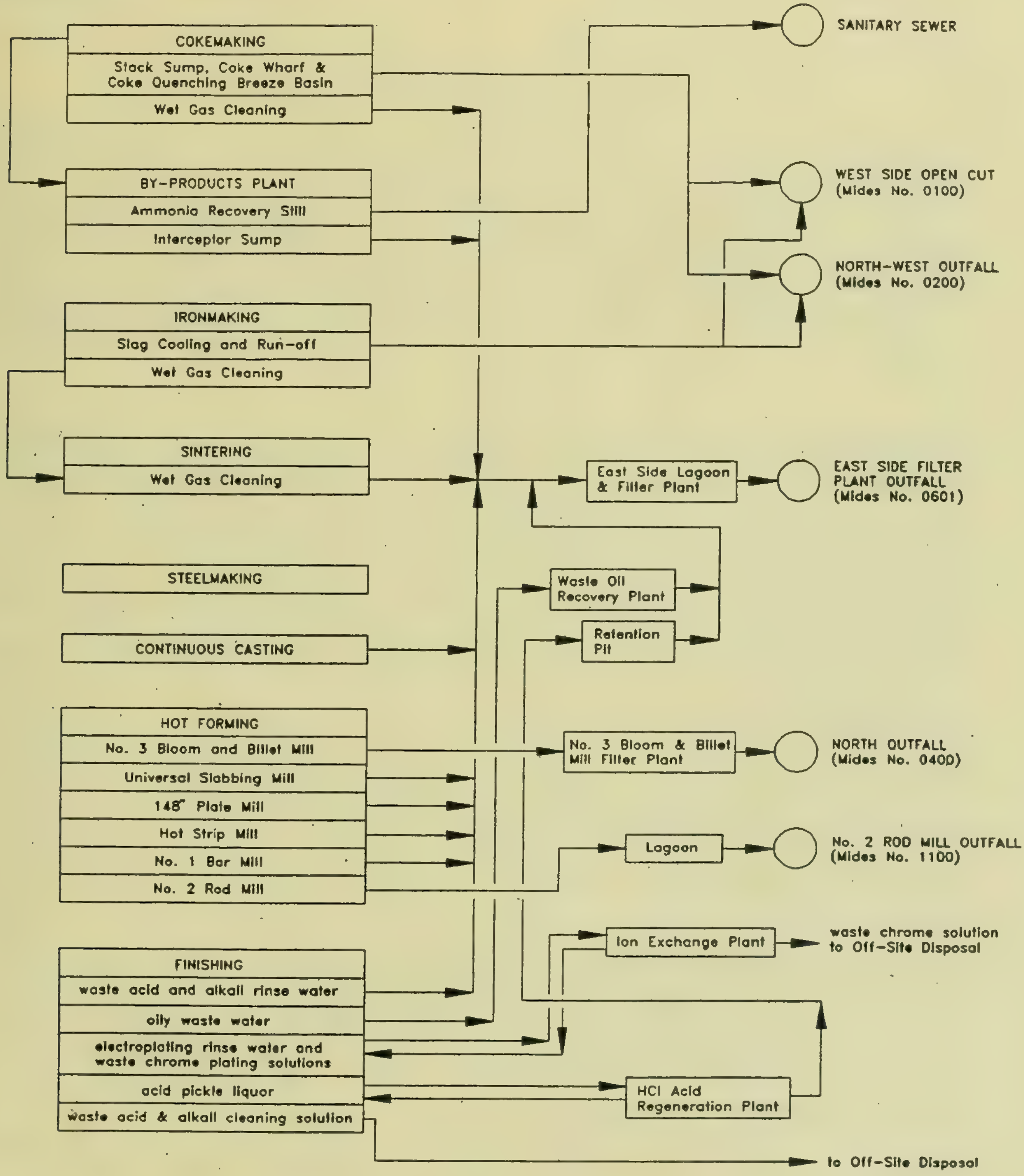
Hot Forming

There are six hot forming mills at Stelco Hilton: the Universal Slabbing Mill, #3 Bloom & Billet Mill, 148" Plate Mill, Hot Strip Mill, #2 Rod Mill, and No. 1 Bar Mill. The water treatment systems are similar at each of these mills. Process wastewater is treated in a scale pit before being partially recycled to the mill. Blowdown streams from the Universal Slabbing Mill, 148" Plate Mill, Hot Strip Mill and No. 1 Bar Mill, flow to the ESFP for treatment. NCCW is cascaded and then recycled for use as process water in flume flushing. The #3 Bloom and Billet Mill includes a separate Filter Plant for treatment of the wastewater. Effluent from the #2 Rod Mill, which is at a separate location is sent to a gravity settling lagoon, for solids and oil removal, before discharge to Hamilton Harbour.

Finishing

The finishing operations at Stelco Hilton include Cold Rolling, Cold Rolled Sheet Finishing, Tin Coating, Galvanizing, and Acid Pickling. In summary, emulsified oil from the Cold Rolling operations and recovered oil from all other parts of the plant flow to the Waste Oil Recovery Plant. Rinse water from all finishing operations flows to the ESFP. Spent electroplating solution is collected in a holding tank for off-site disposal. Spent acid from the Acid Pickle Lines is regenerated at the HCl Acid Regeneration Plant and the recovered acid flows back to the process with a 100% recycle rate. Acid regeneration plant scrubber water is directed to the ESFP.

The East Side Filtration Plant includes a two cell sedimentation lagoon with oil skimmers, followed by a Filter Plant. The Filter Plant consists of two parallel filter systems: a bank of gravity filters and a number of pressure filters. Flow through the filters is continuous. Backwash from the filters is recycled to the first cell of the lagoon.



HATCH ASSOCIATES

Figure 2.3 STELCO INC., HILTON WORKS

PROCESS WASTEWATER DISCHARGE STREAMS

2.2.4 Stelco Inc., Lake Erie Works (Stelco LEW)

Overview

Stelco LEW, which is the most modern integrated steel mill in North America, was commissioned in 1980. The mill was constructed on a greenfield site at Nanticoke, Ontario, on the northern shore of Lake Erie. The mill produces approximately 2 million tonnes steel per year, including hot rolled carbon steel. Part of the steel is sold externally and part is sent to Stelco Hilton for finishing.

Process operations at the mill include Cokemaking, Ironmaking, BOF Steelmaking, Vacuum Degassing (RHOB), Continuous Casting, and Hot Forming. There are no Finishing Operations at the mill. The RHOB, the most recent addition, was started up during 1989. The mill was designed with relatively high rate wastewater treatment and recycle systems on each process, and with recirculated NCCW systems for the coke plant, blast furnace, BOF and the power station. The backwash from the hot strip mill is directed to the BOF gas cleaning water recirculation system for solids removal and reuse. Blowdown streams from the recirculated process water systems on the RHOB, continuous caster and BOF system are treated at the Blowdown Treatment Plant. Blowdown from the coke plant non-contact cooling water recirculation system is used as make-up water for coke quenching. Accordingly, the total quantity of water discharge from Stelco LEW is among the lowest of any integrated mill in North America, both in absolute terms and in terms of volume per unit of raw steel production.

The water used at the mill is supplied by the Ministry of the Environment from Lake Erie. The water is filtered and chlorinated by the MOE. Treated process wastewater is discharged to Lake Erie via Centre Creek at a rate of approximately 20 000 m^3/day. The total discharge, including NCCW and stormwater, is approximately 40 000 m^3/day. Figure 2.4 shows the process wastewater discharge streams at Stelco LEW.

Cokemaking

Cokemaking wastewater, including waste ammonia liquor, fractionator bottoms and intercepting sump water, is treated in a free and fixed leg ammonia still for partial ammonia removal and then sent to the Biological Oxidation Plant for further treatment. Pushing emission control wastewater is sent to the quench tower breeze basin for coke quenching. The Biological Treatment Plant consists of a primary clarifier, two aeration basins in series, and a final clarifier. Effluent is sent to the Blowdown Treatment Plant.

Ironmaking

Ironmaking gas cleaning wastewater is clarified, cooled and recirculated back to the gas cleaning scrubber. A polymer is added prior to clarification to aid in solids removal. Part of the blowdown flows to the Blowdown Treatment Plant for final treatment, and part is used for slag quenching. Blast furnace sludge collected in the clarifiers is pumped in slurry form to a tailings lagoon where it is de-watered. The decanted water from the lagoon is pumped to the Blowdown Treatment Plant. Partially de-watered sludge is stored on-site for possible future recovery of iron.

Steelmaking

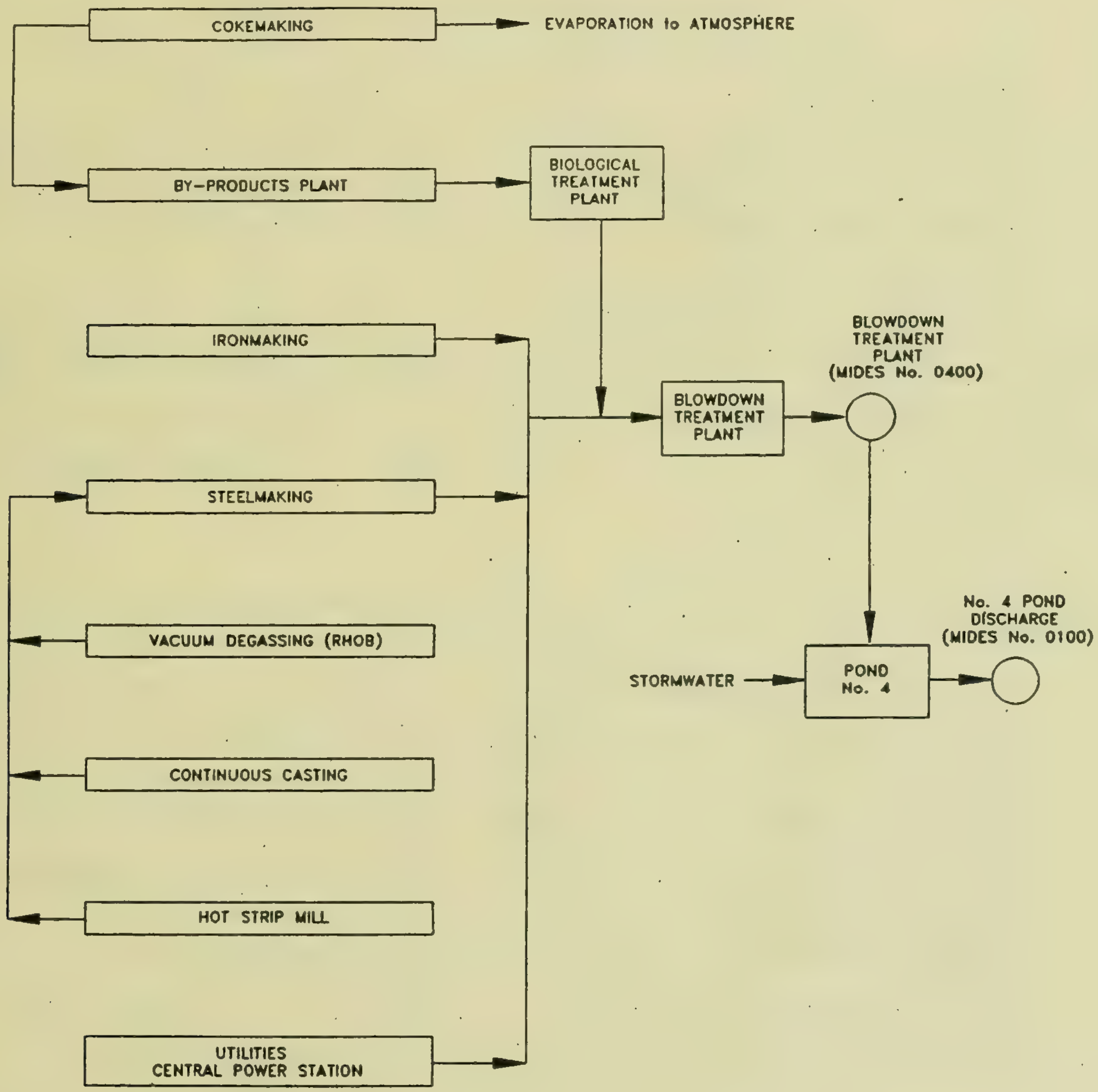
Steelmaking gas cleaning water is processed in classifiers for removal of large solids prior to processing in a thickener for subsequent recycle. Recovered sludge is de-watered in vacuum filters and stored on site. The BOF recirculating system receives blowdowns from the RHOB and the Hot Strip Mill, where solids are removed in vacuum filters. The Vacuum Degasser - RHOB uses a recirculating flow of condenser cooling water. All of the water is cooled and a side stream flow of about 20 % is treated with polymer in an inclined plate separator for control of suspended solids. The cleaned blowdown is directed to the dirty water sump at the BOF gas wash water system.

Continuous Casting/Hot Forming

The Continuous Caster uses a recirculated spray water system. The blowdown, consisting of filter backwash and machine casting water, is directed to the dirty water sump at the BOF gas wash water system. Water used for hot strip mill cooling and cleaning flows to a lagoon, the water is filtered and cooled then is recirculated to the hot strip mill. The only blowdown from the hot strip mill is gravity sand filter backwash which flows to the BOF gas wash water system for

solids removal. The combined blowdowns from the BOF, RHOB and Continuous Caster are discharged to the Dirty Water Sump, then to the Blowdown Treatment facility for further treatment.

There are two treatment system in the blowdown treatment plant. The first system treats the water from the BOF, RHOB and Continuous Caster blowdown streams, and the blowdown from the Central Power Station. The second treatment system treats the effluent from the coke plant biological treatment plant and the blast furnace blowdown. The blowdown treatment plant effluent is combined with non-contact cooling water and stormwater in Pond #4 prior to discharge to Lake Erie.



HATCH ASSOCIATES

Figure 2.4 STELCO INC., LAKE ERIE WORKS

PROCESS WASTEWATER DISCHARGE STREAMS

2.3 Non-Integrated Mills, Mini Mills and Specialty Mills

2.3.1 Atlas Specialty Steels (Atlas)

Atlas Specialty Steels, located in Welland, Ontario, is a division of Sammi Atlas Inc.. Atlas employs about 1 200 people. In 1987, the mill produced approximately 200 000 tonnes of steel product including stainless, carbon, low and high alloy, tool, machinery and mining steels in ingot, bloom, billet and bar form.

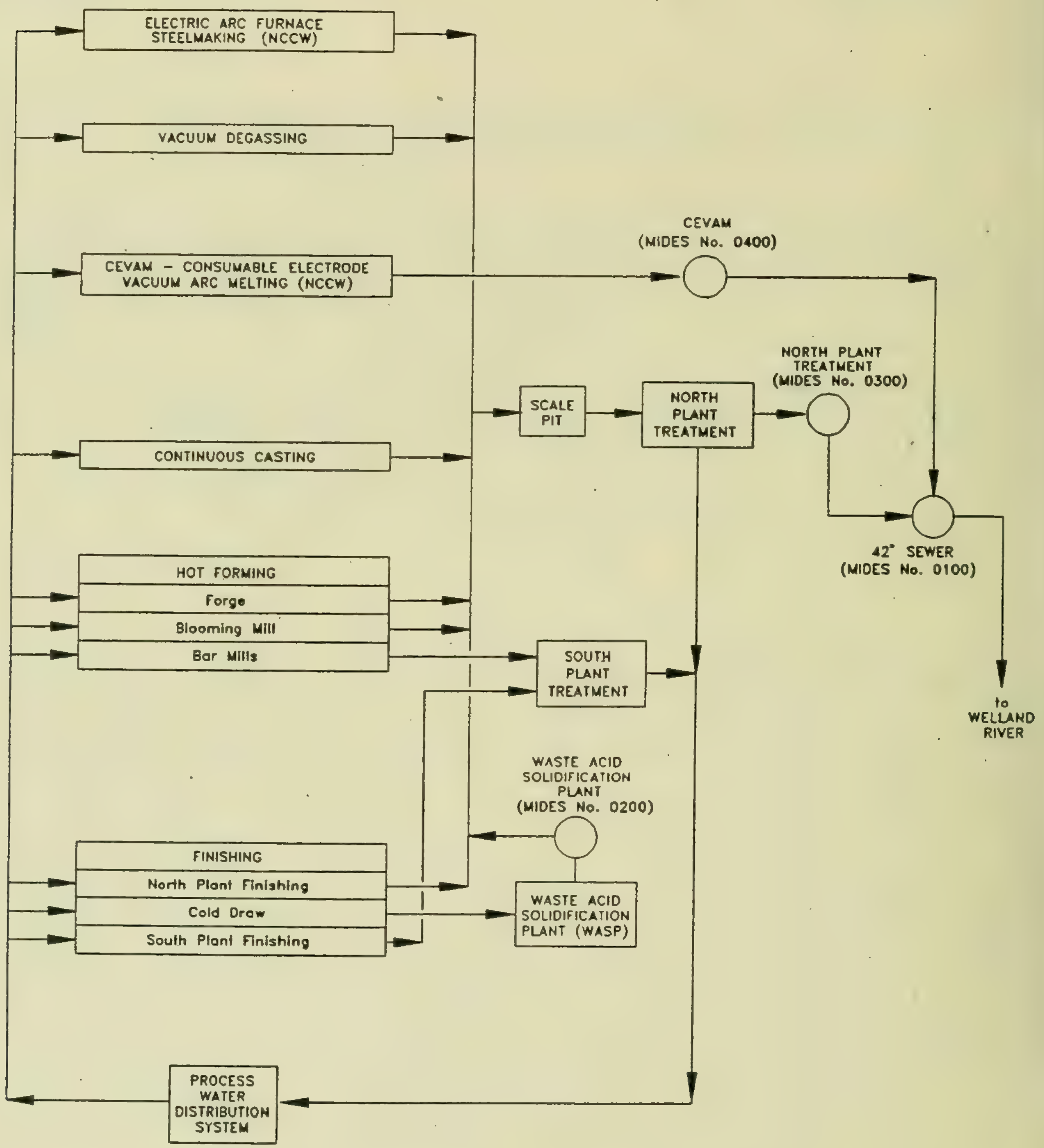
Process operations include Steelmaking (Electric Arc Furnace Melt Shop), Vacuum Degassing (Vacuum Oxygen Refining System, Vacuum Oxygen Degassing, Vacuum Arc Degassing, Consumable Electrode Vacuum Arc Melting), Continuous Casting, Hot Forming Mills (Forge, 26" Blooming Mill, 22" Mill, 10 - 1 Mill, 10 - 2 Mill), and Finishing (Cold Drawing, Annealing, Salt Bath Descaling, Acid Pickling).

Atlas uses water from both the Old Welland Canal and the City of Welland for process and cooling purposes. Recently, Atlas initiated a Canal intake water chlorination program during the months of April - November to combat infestations of zebra mussels. During the summer months water is used on a once-through basis due to its temperature. In the spring and fall about 50% of the water is recycled. In the winter up to 100% of the plant water is recirculated. Atlas currently operates three wastewater treatment facilities: The North Plant Treatment; The South Plant Treatment; and The Waste Acid Solidification Plant (WASP). Atlas operates an integrated water distribution system whereby raw water from the Old Welland Canal, city water and recycled water from the North and South Treatment Systems are combined at various points in main distribution headers and provided to various parts of the mill. All significant water users are provided with a combination of city water, raw water and treated process water. Thus even NCCW is actually a combination of treated process water and fresh water. Wastewater is discharged at a rate of approximately 15 000 m^3/day to the Welland River. Figure 2.5 shows the process wastewater discharge streams at Atlas.

The North Plant treatment system consists of a collection sump, an earthen lagoon with oil skimmers, and a gravity-sand filter system. Polymer is added to the collection sump to aid in settling in the lagoon. The effluent is either returned to the water distribution system, or discharged to the Welland River, depending on the temperature. The South Plant Treatment

System is similar, except that there is no earthen lagoon preceding the gravity-sand filters. The South Plant effluent is returned to the water distribution system. .

The purpose of the WASP is to dispose of the Acid Pickling waste acids, and the Salt Bath Descaling and Acid Pickling rinse waters. Lime and slag are added to the waste acids for neutralization and metal precipitation as hydroxides and silicates. Review of MISA data indicates the plant is difficult to control with respect to maintaining proper pH levels for effective precipitation and removal of suspended solids and toxic metals. To partially overcome this problem, the clarifier overflow was routed to the North Plant Treatment System.



HATCH ASSOCIATES

Figure 2.5 ATLAS SPECIALTY STEELS

PROCESS WASTEWATER DISCHARGE STREAMS

2.3.2 Lake Ontario Steel Corporation (Lasco)

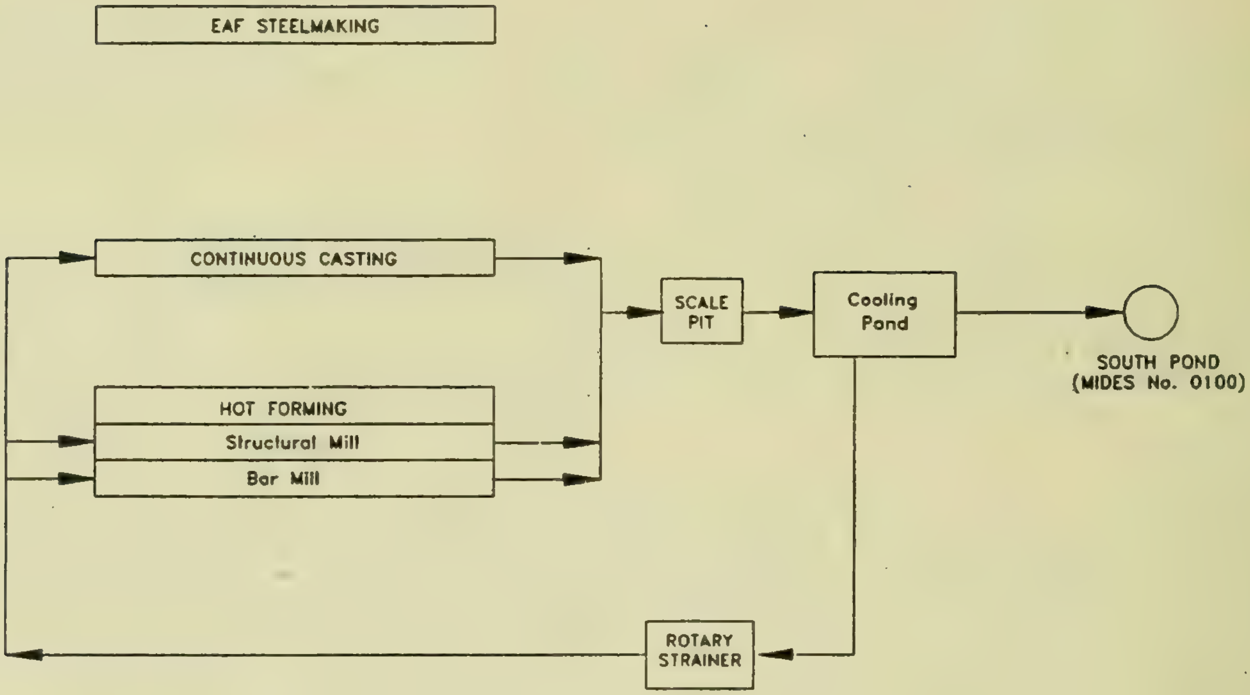
Lasco is located in Whitby, Ontario and employs about 600 people. In 1990, the mill produced 600 000 tonnes of low grade carbon steel bars and alloy steel round bars.

The mill uses two electric arc furnaces to melt scrap steel. Two Continuous Billet Casting Machines cast the steel into billets and the Hot Forming operations take place at a ten stand Light Structural Mill and a 17 stand Bar Mill.

Lasco purchases untreated lake water by a pumping station operated by the Town of Whitby. Lake water is used to provide make up water to the non-contact water systems after the addition of water treatment chemicals. The mill discharges wastewater to Lake Ontario at a rate of approximately 6 800 m^3/day. Figure 2.6 shows the process wastewater discharge streams at Lasco.

Direct contact cooling water is used to cool the Light Structural mill, the Bar Mill, and the Billet Casters. The effluent is pumped to one of two alternating scale pits for the removal of heavy solids. Overflow from the scale pit goes to a cooling and settling pond where the smaller solids settle out. A travelling rope type skimmer is used to remove oil from the cooling pond. The cooling pond is connected to a cold well where six mill supply pumps return the water to the mill after straining by three rotating type strainers. The level of dissolved solids is controlled with a blowdown stream which goes to a final settling pond for solids removal prior to discharging into Lake Ontario.

NCCW is recirculated over a cooling tower open to the atmosphere. The blowdown stream is directed to the mill pond.



HATCH ASSOCIATES

Figure 2.6 LAKE ONTARIO STEEL COMPANY LIMITED

PROCESS WASTEWATER DISCHARGE STREAMS

2.3.3 Ivaco Rolling Mills (Ivaco)

Ivaco is located in L'Orignal, on the Ottawa River. The mill employs about 540 people. It is a non-integrated mini mill which uses scrap steel to produce medium and low grade carbon steel billets, wire rod and various other machined parts. In 1987, the steelmaking capacity of the mill was approximately 500 000 tonnes per year. The mill currently recycles 100% of its process water and discharges approximately 110 m^3/day NCCW to the Ottawa River via Mill Creek. Ivaco advise that they cannot maintain zero discharge at this time and they have requested approval to discharge an average flow of 0.26 m^3/tonne up to a maximum of 1.0 m^3/tonne. Figure 2.7 illustrates the current Ivaco system.

The mill uses two electric arc furnaces to melt scrap steel. A continuous casting machine then produces billets and finally wire rod is produced in a hot forming rolling mill.

There are two main plant water systems, the Melt Shop Water System and the Rod Mill Water System. The Melt Shop Water System consists of three process water systems, Arc Furnace Water, Mold Cooling Water and Billet Spray Cooling Water. The Rod Mill Water System includes three process water systems, Mill Water, Cooling Tower #1 and Cooling Tower #2.

The Arc Furnace Water system recirculates NCCW over an evaporative cooling tower and provides cooling for the electric furnaces and miscellaneous heat exchangers and air conditioner heat exchangers. The two reservoirs for this system, a hot well and a cold well, are connected such that the water level will equalize. Blowdown from the cooling tower is discharged to the scale pit in the Billet Spray Water system. Sidestream sand filtration of furnace water is performed continually. Backwash of the sand filters is discharged to the mill pond.

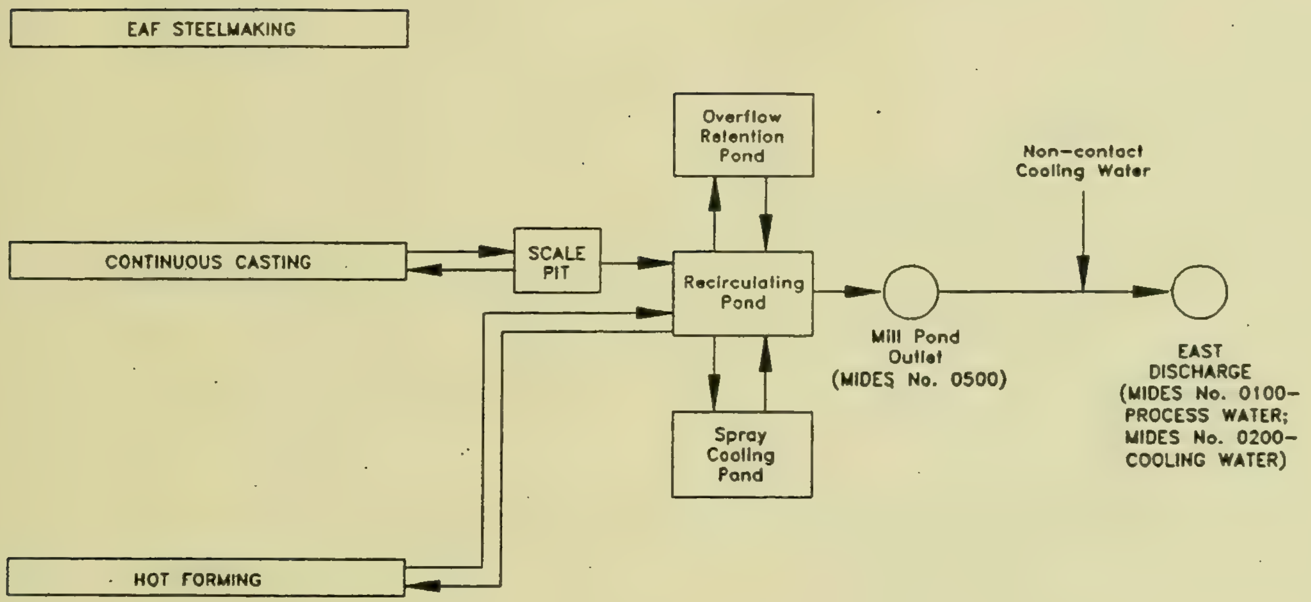
The Mold Cooling Water system is a closed system that provides cooling to the molds in the continuous caster. Backwash from the softener is discharged to the cold well in the Arc Furnace Water system.

Billet spray water is used for direct contact cooling of the cast steel billets. The water passes through one of two Adams filters, and is then divided between each of the four strands on the

casting machine. The effluent then flows from an open flume to a scale pit before recirculation to the casting machine. Backwash from the Adams filters is discharged to the mill pond.

The Mill Water System is used for direct contact cooling of rolls in the rod mill during the hot forming process (manufacture of steel rods). The water circulates from the rod mill, to the mill flume, to the scale pond, to the mill pond, to the spray pumphouse, to the spray pond, to the mill pumphouse and back to the rod mill. The mill pond has not been blown down other than drift loss from the spray cooling system since February, 1988. In the future, blowdown may be required to prevent operating difficulties due to the build-up of dissolved solids. Ivaco has selected a treatment technology for the treatment of a mill water blowdown stream.

The Cooling Tower #1 Water System recirculates NCCW over an evaporative cooling tower and provides cooling for heat exchangers in the rod mill. The Cooling Tower #2 Water System recirculates NCCW over an evaporative cooling tower and provides cooling for the rod mill re-heat furnace. Cooling water blowdown from both Cooling Tower Systems is discharged after blending with an equal amount of raw river water.



HATCH ASSOCIATES

Figure 2.7 IVACO ROLLING MILLS

PROCESS WASTEWATER DISCHARGE STREAMS

3.0 AVAILABLE DATA AND INFORMATION SOURCES

3.1 Introduction

Data was taken from the following unit operations to develop the Model BAT options and the Applied BAT options: production operations, water usage and management, and wastewater treatment. The information was obtained from the following sources:

- Ontario Mill Initial Reports;
- EPA Development Documents and Regulations;
- MISA Program effluent data;
- Environment Canada Treatment Facilities Performance Evaluation Studies;
- the results of a technical literature review;
- the responses to a questionnaire sent to each Ontario iron and steel mill; and,
- the information collected during visits to mills in Ontario, the United States and in selected overseas locations.

The following sections describe these information sources in more detail and give the reason each was used for this study.

3.2 Ontario Mill Initial Reports

As part of the MISA Effluent Monitoring Regulation, initial reports were submitted to the Ministry of the Environment (MOE) by each Ontario iron and steel mill. The reports contained a brief description and schematic diagram of all process areas and wastewater treatment facilities. Stormwater diagrams for all mills were included. Process production data and many water and wastewater flowrates were not given in these reports.

All information relevant to the current study was extracted from the Initial Reports and used to partially fill in the mill questionnaires. (see Section 3.7).

Certificates of Approval for all wastewater treatment facilities at Stelco Hilton and Stelco LEW were also obtained from the MOE for the purposes of this study.

3.3 EPA Development Documents and Regulations

3.3.1 Introduction

A program similar to the MISA initiative was undertaken in the USA by the EPA in the late 1970s. The program resulted in a series of Development Documents, the effluent limitations guidelines for use within the National Pollutants Discharge Elimination System (NPDES) framework. The limitations and Standards for the Iron and Steel Sector were initially proposed in January 1981, promulgated in May 1982, and amended in July 1984 after extensive litigation by industry and a national environmental group.

Prior to this, the EPA had studied the iron and steel industry to determine whether differences in raw materials, final products, manufacturing processes, equipment, age and size of plants, water usage, wastewater constituents, and other factors justified the development of separate effluent limitations and standards for different segments of the industry.

The EPA also collected information concerning production processes, production capacity and rates, process water usage, wastewater generation rates, wastewater treatment and disposal methods, treatment costs, location, age of production and treatment facilities, as well as analytical information on influent and effluent quality from 391 steelmaking operations and 1,632 steel forming and finishing operations.

Detailed information was collected on long-term effluent monitoring data and specific production operations from 50 basic steelmaking facilities and 128 forming and finishing facilities.

Effluent analysis and flow monitoring were conducted at representative iron and steel plants to determine the presence and level of conventional and priority pollutants in iron and steelmaking effluent. Also, a two-part sampling and analysis program at 31 basic steelmaking facilities and 83 forming and finishing facilities was completed.

After an extensive review of the data that was obtained from these studies, the EPA adopted a scheme based on process categorization. Process-based categorization was warranted for the following reasons:

- the data suggested that similar iron and steel process categories produce wastewaters with similar characteristics regardless of mill location;

- it accurately reflects production operations;

- the wastewaters of different processes contain different pollutants requiring treatment by different control systems;

- the process water usage and wastewater flows for the iron and steel sector vary significantly among different process categories thus affecting the type of treatment used.

Average wastewater concentrations and loadings for each conventional and priority pollutant were determined for each process category. These concentrations and loadings were used to determine the effluent limitations guidelines for each process category. Effluent limitations were established for Best Practicable Treatment Currently Available (BPTCA); Best Available Treatment Economically Achievable (BATEA); and Best Conventional Pollutant Control Technology (BCT). EPA also promulgated New Source Performance Standards (NSPS); and Pre-treatment Standards for New and Existing Sources (PSNS, PSES) discharging to POTW's.

The United States Iron and Steel Effluent Limits Regulation controls the discharge of sixteen pollutants: nine priority pollutants and seven conventional pollutants. The data generally showed that the control of these pollutants would result in the comparable control of similar priority and conventional pollutants not specifically limited.

It was concluded that, by establishing specific limitations for indicator pollutants only, the high cost and delays of monitoring and analysis that would result from limitations for each pollutant would be significantly reduced.

The sixteen pollutants limited by the United States Iron and Steel Effluent Limits Regulation are:

Ammonia - N	Total Nickel
Benzene	Naphthalene
Benzo(a)pyrene	Oil and Grease
Total Chlorine	pH
Total Chromium	Phenolics (4AAP)
Total Cyanide	Tetrachloroethylene
Hexavalent Chromium	Total Suspended Solids
Total Lead	Zinc

These pollutants were assigned to specific iron and steel sector process categories based upon the analytical data gathered, the ability of the compound to serve as an "indicator" for the presence of other pollutants and the treatability of each compound. For example, ammonia-N, cyanide, phenolics (4AAP), benzene, naphthalene, and benzo(a)pyrene were assigned to cokemaking operations. EPA set limits for each of these compounds and stated that these limits could be achieved at all cokemaking process category operations. All of the background work was summarized and reported in Development Documents for each process category.

3.3.2 Process Categories

The categorization mentioned above was based primarily upon differences in wastewater quantity and quality related to differences in industry manufacturing processes. EPA adopted a revised categorization of the industry from that used in prior regulations to more accurately reflect production operations in the industry, and to simplify the use of the Regulation. The 12 categories of the steel industry, their subdivisions, and segments are shown in the following pages.

Category	Subdivision	Segment
Cokemaking	By-Product	Iron and Steel; Merchant
	Beehive	
Sintering	-	-
Ironmaking	Iron Blast Furnace Ferromanganese Blast Furnace	-
Steelmaking	Basic Oxygen Furnace	Semi-Wet Wet-Suppressed Combustion Wet-Open Combustion
	Open Heath Furnace	Wet
	Electric Arc Furnace	Semi-Wet Wet
Vacuum Degassing	-	-
Continuous Casting	-	-
Hot Forming	Primary	Carbon and Specialty Mills without Scarfers Carbon and Specialty Mills with Scarfers
	Section	Carbon Mills Specialty Mills
	Flat	Hot Strip and Sheet Mills Carbon Plate Mills Specialty Plate Mills
	Pipe and Tube Mills	-
Salt Bath Descaling	Oxidizing	Batch: Sheet, Plate Batch: Rod, Wire, Bar Batch: Pipe, Tube Continuous
	Reducing	Batch Continuous

Category	Subdivision	Segment
Acid Pickling	Sulphuric Acid	Rod, Wire, Coil Bar, Billet, Bloom Strip, Sheet, Plate Pipe, Tube, Other Fume Scrubber
	Hydrochloric Acid	Rod, Wire, Coil Strip, Sheet, plate Pipe, Tube, Other Fume Scrubber Acid Regeneration
	Combination Acid	Rod, Wire, Coil Bar, Billet, Bloom Strip, Sheet, Plate-Continuous Strip, Sheet, Plate-Batch Pipe, Tube, Other Fume Scrubber
Cold Forming	Cold Rolling	Recirculation: Single Stand Multi-Stand Combination Direct Application: Single-Stand Multi-Stand
	Cold Worked Pipe and Tube	Water Solutions Oil Solutions
Alkaline Cleaning	Batch	-
	Continuous	-
Hot Coating	Galvanizing, Terne and Other Metal Coatings	Strip, Sheet, and Miscellaneous Products Wire Products and Fasteners
	Fume Scrubbers	-

3.3.3 Costing and Economic Analysis

The EPA completed costing and economic analyses to assess the economic impact of the regulations prior to their promulgation. Some of the issues dealt with are pertinent to the present study. Thus the important findings by EPA, related to these issues, are summarized below.

The EPA concluded that the age of facilities does not necessarily have a substantial impact on the cost or feasibility of retrofitting pollution controls because many old facilities are served by modern and efficient retrofitted treatment systems. With regard to the impact of plant age on the cost of retrofitting, most respondents to EPA questionnaires were unable to estimate retrofit costs, reported no retrofit costs, or reported retrofit costs of less than 5% of pollution control costs. EPA compared its model-based cost estimates with actual industry costs for over 90 installed treatment facilities, many of which were retrofitted to older production facilities. It found that the model-based cost estimates were sufficiently generous to account for retrofit costs at both older and newer plants. Also, detailed engineering studies and industry cost estimates for three of the oldest plants in the country produced cost estimates similar to EPA's model plant estimates.

The EPA found that both old and newer facilities generate similar raw wastewater pollutant loadings; that, in many cases, pollution control facilities had been retrofitted to both old and newer production facilities without substantial retrofit costs; that these pollution control facilities were achieving the same effluent quality; and that further categorization or further segmentation within each category on the basis of age was not appropriate.

EPA concluded that categorization or relaxed limitations for older plants was not justifiable. Older plants cause similar pollution problems as newer plants, and the need to control these problems would justify the expenditure of reasonable, if any, additional retrofit costs. Therefore the regulation does not differentiate between old and newer facilities. However, new greenfield plants are subject to more stringent requirements, the NSPS noted above.

The EPA's cost estimates were found to be sufficiently generous to reflect all costs incurred when installing wastewater treatment systems, including site-specific costs. The cost models included several site-specific cost items not included in prior cost models and incorporated several

conservative assumptions. As noted above, EPA also compared its model plant cost estimates with actual costs reported by the industry, including site-specific costs. Detailed plant-by-plant engineering estimates (cost estimates provided by the industry) for eight plants revealed estimated costs (including site-specific costs) similar to EPA's model plant cost estimates. (This is relevant to the present study because the approach to costing is similar to EPA's.) .

EPA temporarily excluded 21 mills or parts of mills with centralized treatment facilities from the Iron and Steel sector regulation for purposes of conducting more detailed cost studies. The owners or operators of those mills were given the opportunity to submit information regarding their estimated costs of compliance. EPA had indicated that, if their cost of compliance had far exceeded EPA's Model Costs, less stringent regulated limits might be granted. Such less stringent effluent limitations were not granted to any of the 21 facilities through the mechanism established in the iron and steel sector regulations. However, some of the mills obtained less stringent effluent limitations through variance mechanisms established by the NPDES permit program.

3.3.4 EPA Reported Data

In Section 5.0 of this report and in various tables throughout this report EPA data is given for regulated parameters for comparison purposes.

This data is the regulation number for the parameter, "Average of daily values for 30 consecutive days" as published under 40 CFR Parts 400 et seq. This number was calculated by EPA by taking the median concentration value of the long term average; for a particular parameter from a number of plants with a similar treatment system. (eg. filtration); multiplied by median of the variability factors from each plant. This number was then rounded up to develop the regulation number. The variability factor was calculated separately for different parameters and for different treatment processes, but typically the effect of applying the variability factor and rounding up will be a regulated number that is 125-150% above the median of the long term averages data point. Thus EPA regulated number for a given parameter has to be used for comparison purposes with MISA with the awareness of the derivation and/or calculation of the data.

3.4 MISA Effluent Data

The MISA Effluent Monitoring Regulation program provided current data on the presence of conventional, non-conventional, and priority pollutants in selected discharge streams at Ontario iron and steel mills. The twelve month MISA Monitoring Period began November 1, 1989. The data was stored in the MIDES (MISA Data Entry System) database. A summary of the effluent data collected over the MISA Monitoring Period was provided to Hatch by the Ministry of the Environment (MOE). The summary included the following parameters: average, maximum, minimum and standard deviation of the concentration results (mg/L); average and standard deviation of the loadings results (kg/day); the Regulation Method Detection Limit (RMDL) (mg/L); the number of samples tested(N); the number of samples with values less than the detection limit, (NLDL).

The MISA effluent monitoring data was received by Hatch from the MOE after the MOE had performed a statistical analysis on the data base. This statistically compiled data was not manipulated further by Hatch. However, Hatch has noted in the Effluent Data sheets and the Predicted Effluent Quality sheets wherever the reported concentration is less than the RMDL.

As outlined in the Ministry Issue Resolution Committee Report, effluent data with remark codes <DL were replaced with $\frac{RMDL}{10}$ if the reported value was less than $\frac{RMDL}{10}$, otherwise the value reported was used to calculate the long term average (LTA).

The MISA effluent data was used for two reasons. It provided the data necessary to determine the BAT #1 option - Best in Ontario. Secondly, it provided the current data for each Ontario mill for comparison with the Applied BAT predicted effluent quality data which was generated as part of the study.

Wherever practicable, effluent streams from process category operations were monitored for the MISA program. This was successful at Dofasco and to a lesser extent at Algoma. Stelco Hilton and LEW works both have central treatment facilities, and in these instances effluent was monitored after the central facilities.

Inevitably, in older mills, some process wastewaters were combined with NCCW and stormwater prior to the monitoring point. Therefore, it was not always possible to assess the performance and effluent characteristics of wastewater treatment facilities.

3.5 Environment Canada Treatment Facilities Performance Evaluation Studies

In mid-March 1991, Environment Canada performed several "Iron and Steel Mill Treatment Facilities Performance Evaluation Studies". These studies included the #2 Hot Mill Filter Plant at Dofasco, the Blowdown Treatment Plant at Stelco LEW, the #3 Bloom and Billet Mill Filter Plant at Stelco Hilton, the East Side Filtration Plant at Stelco Hilton, and the Primary and Secondary Lagoons at Lasco. These studies were reviewed during the course of this work.

3.6 Technical Literature Review

A literature search focusing on effluent treatment in the iron and steel sector was performed. The results are listed in Volume 3 Appendix D-References. The following databases were searched:

- HATCH In-house Database
- Compendex Plus Database
- Pollution Abstracts Database
- NTIS Database
- Enviroline Database
- Metal Abstracts Database

The literature contained several articles describing the production processes and wastewater treatment facilities at Dofasco, Stelco Hilton Works, Stelco Lake Erie Works, and Atlas Specialty Steels. This information was used to aid in developing the mill questionnaires (see Section 3.7).

Descriptions and process flow diagrams for the wastewater treatment facilities at several iron and steel mills in the United States were found in journal articles and resource documents.

In addition, the U.S. EPA Development Documents for Effluent Limitations and Guidelines for the Iron and Steel Point Source Category were consulted.

There were very few references to overseas mills in the literature. However, there were several articles describing the water treatment and conservation practices at the NKK Keihin Works in Japan. The literature also described the coke oven wastewater fluidized bed treatment system at Hoogovens' mill in the Netherlands. There were also articles outlining the production process operations at the Kwangyang Works of the Pohang Iron and Steel Company (POSCO), and several iron and steel mills in Germany.

The literature contained many general references to wastewater treatment in the iron and steel industry, including the following treatment methods and technologies:

- water management and conservation;
- water recycling;
- pretreatment of make-up water;
- wastewater toxicity.
- suspended solids removal;
- removal of organics (incl. halogenated organics);
- biological treatment (of coke plant waste);
- treatment of ammonia liquor;
- acid pickling liquor regeneration and recovery;
- removal of inorganics; and
- removal of heavy metals.

All of the above references are listed in Volume 3 - Appendix D.

3.7 Ontario Industry Questionnaire and Responses

At the beginning of the study, a questionnaire was developed to facilitate the acquisition of information about flow and wastewater treatment facilities at the Ontario mills. Specifically, the questionnaire requested wastewater flows, recycle rates, factors determining blowdown rates, flow diagrams relating to water usage, treatment and discharge and a production profile for the mill.

The questionnaires were partially completed by Hatch staff using the following data sources:

- MISA Initial Report from each Ontario mill (Section 3.2);
- Technical Literature review (Section 3.6);
- Hatch In-house database.

The questionnaires were sent to the Ontario mills prior to the mill visit. Responses to the questionnaires were received both during and after the mill visit.

3.8 Mill Visits

3.8.1 Ontario Mills

Initial visits were made to each Ontario mill to gather information concerning water management and wastewater treatment. The mill visit reports are given in Volume 3 Appendix A.

A second mill visit was made to most of the Ontario mills during the costing phase of the study, to evaluate the upgrade and retrofit requirements. Additional visits were made for Stelco, Dofasco and Algoma in order to discuss the Applied BAT Options.

3.8.2 United States Mills

Ten iron and steel mills in the United States were visited and information was obtained from the EPA for a further three mills. The mill visit reports and mill reports are included in Volume 3 Appendix B. The information gathered regarding these mills was used to determine the BAT #2 Model BAT Options - Best in the United States.

The following US mills were visited:

- National Steel Corp., Midwest Division, Portage, Indiana due to its finishing wastewater treatment plant;

- Wheeling - Pittsburgh Steel Corp., Steubenville North Plant, Steubenville, Ohio due to its high rate ironmaking effluent recycle system and blowdown treatment;

- USX Corp., USS Gary Works, Gary, Indiana due to its tight recycle and blowdown treatment of sintering, ironmaking, continuous casting, vacuum degassing, hot forming and finishing effluent;

- Wheeling - Pittsburgh Steel Corp., Mingo Junction Plant, Mingo Junction, Ohio due to its high rate recycle of ironmaking effluent and treatment of blowdown and its tight recycle of BOF steelmaking effluent with a new sulphide precipitation blowdown treatment plant;

- Bethlehem Steel Corp., Burns Harbour Plant, Chesterton, Indiana due to its tight recycle of process waste and central blowdown treatment plant;

- LTV Steel Corp., Indiana Harbour Works, East Chicago, Indiana due to its finishing wastewater treatment plant;

- Inland Steel Corp., Indiana Harbour Works, East Chicago, Indiana due to its cokemaking biological treatment system;

- USX Corp., USS Clairton Works, Clairton, Pennsylvania due to its cokemaking ammonia and cyanide removal process;

- USS/Kobe Steel Corporation, Lorain, Ohio due to its very tight ironmaking gas cleaning recycle system;

- LTV Steel Company, Cleveland Works, Cleveland, Ohio due to its unique ironmaking and BOF steelmaking gas cleaning recycle systems and its tight hot forming recycle system.

- Nucor Steel Company, Crawfordsville, Indiana, a mini mill with a closed loop recycle water system, and cold lime softening process.

Mill information was obtained on the following US mills:

- Bethlehem Steel Corp., Sparrows Point Plant, Sparrows Point, Maryland due to its sintering gas cleaning recycle system;

- National Steel Corp., Granite City Div., Granite City, Illinois due to its central treatment facility;

- Mercury Stainless, Inc., Massilon, Ohio due to its treatment of specialty mill finishing wastewater.

3.8.3 Overseas Mills

The terms of reference, for the study specified the following countries for the selection of the BAT #3 Option - Best in the World: Ontario, United States, Holland, Japan, South Korea, Germany.

The following overseas mills were visited:

- Thyssen Stahl AG, Duisberg, Germany;
- Hoogovens, Ijmiuden, Netherlands;
- Nippon Kokan KK, Keihin Works, Japan;
- Pohang Iron and Steel Co., Ltd., Kwangyang Steel Works, South Korea.

The Thyssen Stahl AG mill in Duisberg was visited because the mill currently meets the most stringent criteria in Germany for water recycle and blowdown treatment.

Hoogovens is the only iron and steel company in Holland. New government regulations in 1990/1991 forced the mill to significantly upgrade their wastewater treatment facilities. One important reason for the visit was to view and obtain data on their coke oven wastewater fluidized bed treatment system.

The Nippon Kokan KK (NKK), Keihin Works was visited because the plant was reputed to have the best wastewater treatment facilities in Japan. The Keihin Works of NKK is a relatively modern mill.

The Pohang Iron and Steel Co., Ltd., Kwangyang Steel Works, South Korea was chosen as part of this study because it is the most modern integrated steel mill in the world and it was reputed to include the most modern effluent treatment facilities.

The mill visit reports for the overseas mills are included in Volume 3 Appendix C.

3.9 Toxicity Data

3.9.1 Definition of Toxicity for Use in BAT #4

The goal of the BAT #4 option was to identify technologies which would lead to non-lethal effluents. However, before acquiring toxicity data, it was necessary to develop a definition of toxicity, based on accepted protocols. The final report of the MISA Issue Resolution Committee on toxicity recommends and explains the application of aquatic toxicity testing as a means of providing a consistent basis for the development of regulations.

Toxicity tests are essential for a complete effluent treatment program. While the monitoring and removal of specific contaminants is a large part of such a program, synergistic effects or unidentified toxins may increase the toxicity of the effluent. Since protection of aquatic life is the end goal, toxicity testing must be carried out in addition to chemical characterization.

To provide a test representative of freshwater aquatic life, both rainbow trout (Salmo gairdneri) and the crustacean Daphnia magna are to be considered for toxic effects. Trout are used as they represent a commercial, recreational, and aesthetic value of water. They are slow to adapt to changes in their environment, which could lead to a loss of rare sub-species in the event of a sudden toxic discharge. Daphnia are a less complex organism than trout, but nevertheless represent an essential component of a healthy aquatic ecosystem. Despite the differences in complexity of the two test species, toxicity results vary with the effluent tested, with trout sometimes more sensitive than Daphnia and vice versa.

For an effluent to be considered non-lethal, there must be 50% survival of a test population after exposure to a 100% strength effluent sample for a defined period of time. While the use of undiluted samples may be considered stringent, the measure of toxicity is in terms of acute lethality, the least stringent measure. Should an effluent fail such a test, dilutions may be

performed to determine the LC50 of the effluent, where LC50 is the concentration at which the sample is lethal to 50% of the test population.

3.9.2 Ontario Toxicity Protocols

To further standardize toxicity testing, the Ontario toxicity test protocols for trout (Craig et al., 1983: MOE) and Daphnia (Poirier et al., 1988: MOE) are used. Statistical methods are employed to estimate the LC50 values of toxic effluents to a 95% confidence level. The Issue Resolution Committee notes that the protocols for federal toxicity testing may at some point be considered equivalent to the Ontario protocols, which would be beneficial in avoiding duplicate testing.

3.9.3 Toxicity Data References

While it is acknowledged that chemical characterization of an effluent to sub-lethal concentrations of individual contaminants does not ensure biocompatibility, such an approach provides a readily quantifiable starting point towards non-lethality. Thus, toxicity data in terms of LC50 values for each contaminant can be compiled and used to evaluate effluent quality.

To obtain LC50 values for contaminant parameters, a number of sources were consulted. Correspondence with the MOE resulted in a table of acute LC50 values. These data were obtained from an AQUIRE database, as well as available and draft acute toxicity data tables prepared for the Ontario Water Quality Objectives/Guidelines.

EPA documents were also consulted as a basis of comparison, and for values not found in provincial documents.

As well, the Ontario Water Quality Objectives/Guidelines, Ontario Drinking Water Guidelines, Canadian Water Quality Objectives, and Canadian Drinking Water Guidelines were used to provide an example of currently acceptable levels.

4.0 SELECTION OF KEY CONTAMINANT PARAMETERS FOR ASSESSMENT OF BAT OPTIONS

4.1 Review of MISA Data

As a result of the MISA Monitoring Program, long term average concentrations and loadings of conventional, non-conventional and priority pollutants could be compiled into a database. The MOE performed a statistical analysis on the MISA Effluent Data in which certain parameters were removed from the parameter list. The criteria for removal was if a statistically determined 0.90 proportion of the data set was less than the trigger value for that substance at 95% confidence level. The trigger value used by the MOE for the Iron and Steel Sector was the RMDL. In addition, upon evaluation by the MOE, nineteen incongruous parameters, not typically present in iron and steel mill effluent, were removed from the parameter list. Based on this analysis, a Parameter Selection list consisting of forty-eight parameters was submitted to Hatch for BAT review.

The Parameter Selection List was then further evaluated by Hatch and a list of parameters for the assessment of BAT treatability, in each sub-sector and each category of the Integrated Mills sub-sector, was developed.

4.2 Methodology of Parameter Selection For BAT Evaluation

The forty-eight parameters to be reviewed for use in determining the Best Available Technology (BAT) Options are listed in Table 4.1 *Selection of BAT Parameters - Reference Data*. The pollutants are grouped under the headings conventional, non-conventional, other or Effluent Monitoring Priority Pollutants List (EMPPL) parameters. The EMPPL parameters are further broken down into their current status as persistent and/or bioaccumulative pollutants.

The Regulation Method Detection Limit (RMDL) in units of mg/L is given for each parameter. Various guidelines under the Ontario Water Resources Act (November, 1978; revised May, 1984) are listed for reference. These include the Provincial Water Quality Objectives (PWQO), the Provincial Drinking Water Quality Objectives (PDWQO) and the Objectives for the Control of

TABLE 4.1: SELECTION OF BAT PARAMETERS

Reference Data

TYPE OF POLLUTANT	POLLUTANT	RMDL	ONTARIO WATER RESOURCES ACT		
			PWQO	PDWQO + MAC ++ MDC	OBJ. FOR CONTROL OF IND. EFF. IN ONT.
		(mg/L)	(mg/L)	(mg/L)	(mg/L)
CONVENTIONAL	total suspended solids (TSS)	5	-	-	15 > source
NON-CONVEN.	ammonia + ammonium	0.25	0.02	-	10 (ammonia)
	cyanide total	0.005	free 0.005	free 0.2 +	-
	dissolved organic carbon (DOC)	0.5	-	-	-
	iron	0.02	0.3	0.3 ++	-
	nitrate + nitrite	0.25	-	11 +	-
	oil and grease	1	inoffensive	-	15
	phenolics (4AAP)	0.002	0.001	0.002 ++	20 ppb
	specific conductance	5 US/CM	-	-	-
	sulphide	0.02	-	inoffensive ++	-
	total kjeldahl nitrogen	0.5	-	-	-
	total organic carbon (TOC)	5	-	5.0 ++	-
	volatile suspended solids (VSS)	10	-	-	-
OTHER	total phosphorus	0.1	0.01	-	-
EMPPL	antimony	0.005	undefined	-	-
Persistent/	nickel	0.02	0.025	-	1.0
Bioaccumulative	anthracene	0.0012	-	-	-
	benz(a)anthracene	0.0005	-	-	-
	benzo(a)pyrene	0.0006	undefined	-	-
	benzo(b)fluoranthene	0.0007	-	-	-
	benzo(g,h,i)perylene	0.0007	-	-	-
	benzo(k)fluoranthene	0.0007	-	-	-
	crysene	0.0003	-	-	-
	fluoranthene	0.0004	-	-	-
	indeno(1,2,3-cd)pyrene	0.0013	-	-	-
	perylene	0.0015	-	-	-
	phenanthrene	0.0004	-	-	-
	pyrene	0.0004	-	-	-

Files: MISALST1.WK1 and MISALST1.ALL

TABLE 4.1: SELECTION OF BAT PARAMETERS (continued)

Reference Data

TYPE OF POLLUTANT	POLLUTANT	RMDL (mg/L)	ONTARIO WATER RESOURCES ACT PWQO (mg/L)	PDWQO + MAC ++ MDC (mg/L)	OBJ. FOR CONTROL OF IND. EFF. IN ONT. (mg/L)
EMPPL Persistent / NOT Bioaccumulative	arsenic	0.005	0.1 *	0.05 +	-
	cobalt	0.02	undefined	-	-
	molybdenum	0.02	undefined	-	-
	zinc	0.01	0.03 *	5.0 ++	1.0
Persistent / UNKNOWN Bioaccumulative	aluminum	0.03	undefined	-	-
	cadmium	0.002	0.0002 *	0.005 +	0.001
	chromium	0.02	0.1 *	0.05 +	1.0
	hexavalent chromium	0.01	-	-	-
	copper	0.01	0.005 *	1.0 ++	1.0
	lead (Note 1)	0.03	0.005 - 0.025	0.05 +	1.0
	selenium	0.005	0.1 *	0.01 +	-
	vanadium	0.03	undefined	-	-
NOT Persistent / NOT Bioaccumulative	acenaphthylene	0.0014	-	-	-
	benzene	0.0005	undefined	-	-
NOT Persistent / UNKNOWN Bioaccumulative	fluorene	0.0017	-	-	-
	toluene	0.0005	undefined	-	-
UNKNOWN Persistence / NOT Bioaccumulative	chloroform (Note 2)	0.0007	undefined	-	-
	m-xylene and p-xylene	0.0011	-	-	-
	naphthalene	0.0016	undefined	-	-
	o-xylene	0.0005	-	-	-

Notes: 1. The toxicity of lead is highly dependent on the alkalinity of the water. Lead toxicity decreases as the alkalinity increases.

2. Chloroform is not typically found in iron and steel mill wastewater. This parameter is currently under evaluation by the MOE and industry.

Files: MISALST2.WK1 and MISALST2.ALL

Industrial Waste Discharges in Ontario. The PDWQO parameter levels are classified as either Maximum Acceptable Concentration (MAC) or Maximum Desirable Concentration (MDC).

The criteria used for selection of the parameters to be assessed in this study were as follows:

- There was treatment performance data readily available in the iron and steel sector;
- The pollutant was known to be treatable with proven technology;
- The pollutant was known to be generated within a process;
- The pollutant was representative of a class of pollutants or the pollutant was indicative of the overall treatment effectiveness of a process.

As shown in Table 4.2 *Selection of Parameters for BAT Evaluation - Hatch Screening Based on Treatability*, each parameter was classified as follows:

1 = no data available (in the iron and steel sector)
2 = treatable
3 = not treatable.

The parameters classified as "treatable" were then selected for assessment of BAT options if they were known to be generated within the particular sub-sector or subcategory. These parameters are highlighted in the table.

4.3 Incongruous Parameters for Further Evaluation

As mentioned above, nineteen incongruous parameters not typically found in iron and steel mill effluent were removed from the MOE Parameter Selection List by the MOE. These parameters were thallium, arsenic, mercury, bromoform, dibromochloromethane, dibenz(a,h)anthracene, hexachlorobenzene, 4-bromophenyl phenyl ether, 2,3,7,8 Tetrachlorodibenzo-p-dioxin (2,3,7,8 TCCD), octachlorodibenzo-p-dioxin, total hexachlorodibenzo-p-dioxin (H6CDD), total hexachlorodibenzofuran (H6CDF), total heptachlorodibenzofuran (H7CDF), total pentachlorodibenzo-p-dioxin (PCDD), total pentachlorodibenzofuran (PCDF), total tetrachlorodibenzo-p-dioxin (TCDD), total tetrachlorodibenzofuran (TCDF), methylene chloride, and tetrachloroethylene.

The Ontario Ministry of Environment advises that octachlorodibenzo-p-dioxin and octachlorodibenzofurans were found in two samples in both the intake (average concentrations of 0.840 ng/L and 0.155 ng/L respectively) and the final discharge (average concentration of 0.400 ng/L and 0.075 ng/L respectively) of Atlas Specialty Steels. Total tetra-, penta-, hexa-, hepta-, and octachlorodibezofuran were found in one sample at one outfall in Stelco Hilton Works (average concentrations ranging from 0.083 ng/L to 0.930 ng/L) prior to diversion of the process effluent from this outfall in May 1990. Octachlorodibenzofuran was found at two outfalls in one sample each at Algoma Steel (average concentration of 1.000 ng/L and 0.069 ng/L respectively). There are no known sources of these compounds within the iron and steel production processes.

Bromoform, dibromochloromethane and chloroform are trihalomethanes and may be expected to be found in the LEW effluent, due to the application of alkaline breakpoint chlorination.

Concentrations of these compounds are less than the water quality objectives for trihalomethanes for potable water supplies.

Chloroform is currently under evaluation by the MOE and industry. Chloroform was found in a non-contact cooling water stream at Ivaco and in process water streams at Stelco Hilton and Stelco LEW. As mentioned above, chloroform was expected to be found in the LEW effluent due to the application of alkaline breakpoint chlorination. Non-contact cooling water is typically chlorinated to control microbiological growth (i.e. algae). Free chlorine is a monitored parameter in the USA.

TABLE 4.2 SELECTION OF PARAMETERS FOR BAT EVALUATION

HATCH Screening Based on Treatability

TYPE OF POLLUTANT	POLLUTANT	HATCH SCREENING 1 = NO DATA 2 = TRTABLE 3 = NOT TRTABLE	INTEGRATED MILLS							NON-INTEGR.	
			NCCW	COKE-MKNG	BF & SINT. (Note 1)	BOF & C. C.	HOT FORM.	FIN.	CNTRL TRTMT	SPEC.	MINI
CONVENTIONAL	total susp. solids (TSS)	2		*	*	*	*	*	*	*	*
NON-CONVEN.	ammonia + ammonium	2		*	*				*		
	cyanide total	2		*	*				*		
	diss. org. carbon (DOC)	1,2									
	iron	1,2									
	nitrate + nitrite	1,2									
	oil and grease	2		*	*	*	*	*	*	*	*
	phenolics (4AAP)	2		*	*				*		
	specific conductance	3									
	sulphide	1,2									
	total kjeldahl nitrogen	1,2									
	total organic carbon (TOC)	1,2									
	volatile susp. solids (VSS)	2									
OTHER	total phosphorus	2									
EMPPL	antimony	1,2									
Persistent/	nickel	2								*	
Bioaccumulative	anthracene	2									
	benz(a)anthracene	2									
	benzo(a)pyrene	2		*	*				*		
	benzo(b)fluoranthene	2									
	benzo(g,h,i)perylene	2									
	benzo(k)fluoranthene	2									
	crysene	2									
	fluoranthene	2									
	indeno(1,2,3-cd)pyrene	2									
	perylene	2									
	phenanthrene	2									
	pyrene	2									

Note 1: Oil and grease is typically found in Sintering wastewater but not Ironmaking wastewater.

Files: MISALST3.WK1 and MISALST3.ALL

TABLE 4.2: SELECTION OF PARAMETERS FOR BAT EVALUATION

HATCH Screening Based on Treatability (continued)

TYPE OF POLLUTANT	POLLUTANT	HATCH SCREENING 1 = NO DATA 2 = TRTABLE 3 = NOT TRTABLE	INTEGRATED MILLS							NON-INTEGR.	
			NCCW	COKE-MKNG	BF & SINT.	BOF & C. C.	HOT FORM.	FIN.	CNTRL TRTMT	SPEC.	MINI
<u>EMPPL</u>	arsenic	1,2									
Persistent /	cobalt	1,2									
NOT	molybdenum	1,2									
Bioaccumulative	zinc	2			*	*		*	*	*	*
Persistent /	aluminum	1,2									
UNKNOWN	cadmium	2								*	
Bioaccumulative	chromium	2						*	*	*	
	hex. chromium	2						*	*	*	
	copper	1,2									
	lead	2			*	*		*	*	*	*
	selenium	1,2									
	vanadium	1,2									
NOT Persistent /	acenaphthylene	2									
NOT Bioaccumulative	benzene	2		*					*		
NOT Persistent /	fluorene	2									
UNKNOWN Bioaccumulati	toluene	2									
UNKNOWN Persistence /	chloroform	1,2									
NOT Bioaccumulative	m– and p–xylene	2									
	naphthalene	2		*					*		
	o–xylene	2									

Files: MISALST4.WK1 and MISALST4.ALL

4.4 Parameters Selected for BAT Evaluation

The parameters selected for BAT evaluation are shown in the Tables 4.3, 4.4, 4.5 and 4.6 entitled *Selection of Parameters for BAT Evaluation*. A total of fourteen parameters were selected for the Ontario Iron and Steel sector including one conventional, four non-conventional, and nine EMPPL pollutants. In addition, pH and toxicity were selected parameters for all wastewater discharges in the Ontario Iron and Steel Sector.

A comprehensive and detailed evaluation of pollutants present in the Iron and Steel sector including physical properties, toxic effects and treatability is given in the EPA Development Document for the Iron and Steel Sector, and is not repeated here. This data was supplemented by Hatch in-house data, Hatch Staff experience and observations from other plants.

4.4.1 Suspended Solids

Total suspended solids (TSS) is a conventional pollutant and a good general indicator of the overall effectiveness of wastewater treatment trains. TSS is present in all wastewater streams in the iron and steel sector.

Suspended solids include both inorganic and organic materials. Inorganic compounds include both compounds of natural origin such as sand, silt and clay, and compounds of process origin such as metal hydroxides. Organic suspended solids are typically oil, grease and tar residues from the cokemaking and finishing operations. Suspended solids are settleable or non-settleable. Settleable solids are typically removed in clarifiers or thickeners under quiescent conditions. Non-settleable solids will either pass through in the effluent or will pass to another treatment phase where they can become entrained as for example in a biological reactor. Flocculants are often added to assist in settling. An example of how suspended solids might be generated within the treatment process is the precipitation of soluble metals by pH adjustment.

TABLE 4.3: SELECTION OF PARAMETERS FOR BAT EVALUATION

Iron and Steel Sector

total suspended solids (TSS)
oil and grease
ammonia + ammonium
cyanide total
phenolics (4AAP)
cadmium
chromium
hexavalent chromium
lead
nickel
zinc
benzene
benzo(a)pyrene
naphthalene
pH
toxicity

Files: OVER2.WK1 and OVER2.ALL

TABLE 4.4: SELECTION OF PARAMETERS FOR BAT EVALUATION

Integrated Mills

	Cokemkng	Sinter. & Iron.	BOF & C. Cast.	Hot Forming	Finish.	Int. Mills
total suspended solids (TSS)	x	x	x	x	x	x
oil and grease	x	x	x	x	x	x
ammonia + ammonium	x	x				x
cyanide total	x	x				x
phenolics (4AAP)	x	x				x
chromium					x	x
hexavalent chromium					x	x
lead		x	x		x	x
zinc		x	x		x	x
benzene	x					x
benzo(a)pyrene	x					x
naphthalene	x					x
pH	x	x	x	x	x	x
toxicity	x	x	x	x	x	x

Files: OVER1.WK1 and OVER2.ALL

TABLE 4.5: SELECTION OF PARAMETERS FOR BAT EVALUATION

Specialty Mills

total suspended solids (TSS)
oil and grease
cadmium
chromium
hexavalent chromium
lead
nickel
zinc
pH
toxicity

Files: OVER4.WK1 and OVER4.ALL

TABLE 4.6: SELECTION OF PARAMETERS FOR BAT EVALUATION
Mini Mills

total suspended solids (TSS)
oil and grease
lead
zinc
pH
toxicity

Files: OVER3.WK1 and OVER3.ALL

Suspended solids may also be removed by filtration.

Suspended solids in receiving water are detrimental to the aquatic ecosystem through increasing the turbidity, thus decreasing light penetration; and in addition; potentially forming deposits on the receiving water bottom.

4.4.2 Organic Compounds

Compounds generated in the various processes used in the iron and steel industry can be generally classified as organic or inorganic.

Organic compounds are generated during cokemaking. Compounds of concern are ammonia, cyanide, phenol and, benzene; and the family of polynuclear aromatic hydrocarbons (PAHs) formed during the cokemaking process. All of these compounds are toxic in various chemical forms.

Optimum removal of ammonia is accomplished via ammonia stripping, biological treatment, (conversion to nitrite and nitrate), and tertiary treatment (break point chlorination). Free cyanide and phenol are both removed by biological treatment and tertiary oxidation treatment (chlorination or permanganate oxidation for cyanide) and/or activated carbon for phenol removal. Benzene, toluene and xylene are recovered in the light oil recovery plant. Benzene, toluene and xylene are known to exhibit deleterious human health effects. Any trace residuals carried over to biological treatment plants are normally removed in the biotreatment facility. PAHs are generally insoluble and become entrained with the sludge in the biological treatment plant.

Organic compounds also originate from the finishing operations. These are typically oils and animal fats from cold rolling. These are optimally removed by gross oil removal (passive flotation) followed by emulsion breaking and dissolved air flotation. Oil and grease in receiving waters may cause aesthetic and taste and odour problems in low concentrations, and impair fish and bird functioning. At the levels found in iron and steel mill wastewater it is generally non-toxic.

Thus from a review of cokemaking and finishing operations, the following compounds were selected as key parameters for an assessment of overall technology performance for organic chemicals generated or used in the processes.

Total Suspended Solids
Oil and Grease
Ammonia (NH_3) + Ammonium (NH_4^+)
Total Cyanide
Phenolic Compounds (4AAP)
Benzene (as representative of Benzene, Toluene and Xylene)
Benzo(a)pyrene and Naphthalene (as representative of PAHs)

An additional reason for selecting these compounds is that having been selected by EPA as parameters for regulation, extensive, complete, reliable data is available for an extended period through the NPDES reporting and monitoring system implemented by EPA for Iron and Steel mills in the USA.

4.4.3 Inorganic Compounds

The inorganic compounds generated by the iron and steel sector are the metals contained firstly in the ore, secondly in the scrap feed to the steel production, and thirdly in the finishing (plating) operations.

The metals that are detected at significant levels in the MISA monitoring program are as follows:

iron	zinc
chromium	aluminum
hexavalant chromium	cadmium
antimony	copper
nickel	lead
cobalt	selenium
molybdenum	vanadium

Metals generally become insoluble as metal salts at pH above 7.0 (eg. zinc at 9.2 to 9.5). Treatment to remove metals is generally therefore pH adjustment followed by flocculant aided precipitation.. The pH may have to be carefully adjusted for these metals that are amphoteric.

Metals selected for evaluation of treatment technology performance are:

1) Lead and zinc for blast furnace and steelmaking operations.

2) Chromium, hexavalent chromium, cadmium (specialty steels) and nickel for finishing and metallurgical operations.

The reasons for selecting these parameters are their environmental significance as toxics, and that having been selected as regulated parameters by EPA, extensive, complete and reliable data is available to permit technology assessment. Cadmium was not selected by the US EPA but is selected here as it is of significance at the specialty mill.

Finally pH and toxicity (for BAT #4) were also evaluated.

4.5 Characteristics of Selected Parameters

The source of information in this section is the EPA Development Document for Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category.

4.5.1 Total Suspended Solids (TSS)

Solids in suspension are aesthetically displeasing, increase the turbidity of the water, reduce light penetration, and impair the photosynthetic activity of aquatic plants. Suspended solids may kill fish and shellfish by causing abrasive injuries and by clogging the gills and respiratory passages of various aquatic fauna. When they settle to form sludge deposits on the stream or lake bed, they are often detrimental to the life in the water. Solids, when transformed to sludge deposit, may damage the aquatic ecosystem by blanketing the stream or lake bed and thereby destroying the living spaces for those benthic organisms that would otherwise occupy the

habitat. Organic solids can use a portion or all of the dissolved oxygen available in the area, thus killing fish and fish food organisms by oxygen depletion from the water.

4.5.2 Oil and Grease

Oil and grease are taken together as one pollutant parameter. This is a conventional pollutant and some of its components are:

- Light Hydrocarbons - light fuels such as gasoline, kerosene, and jet fuel, and miscellaneous solvents.
- Heavy Hydrocarbons, Fuels, and Tars - crude oils, diesel oils, #6 fuel oil, residual oils, slop oils, and in some cases, asphalt and road tar.
- Lubricants and Cutting Fluids - non-emulsifiable oils such as lubricating oils and greases, and emulsifiable oils such as water soluble oils, rolling oils, cutting oils, and drawing compounds; emulsifiable oils may contain fat soap or various other additives.
- Vegetable and Animal Fats and Oils.

These compounds can settle or float, and may exist as solids or liquids depending upon factors such as method of use, production process, and temperature of wastewater.

Oil and grease even in small quantities cause troublesome taste and odour problems. Scum lines from these agents are produced on water treatment basin walls and other containers. Fish and water fowl are adversely affected by oils in their habitat. Oil emulsions may adhere to the gills of fish causing suffocation, and the flesh of fish is tainted when micro-organisms that were exposed to waste oil are eaten. Deposition of oil in the bottom sediments of water can serve to inhibit normal benthic growth. Oil and grease exhibit an oxygen demand.

Many of the organic priority pollutants will be found distributed between the oily phase and the aqueous phase in industrial wastewaters. The presence of phenols, PCB's, PAH's, and almost any other organic pollutant in the oil and grease make accurate characterization of this parameter almost impossible.

Levels of oil and grease which are toxic to aquatic organisms vary greatly, depending on the type and the species susceptibility. However, it has been reported that crude oil in concentrations as low as 0.3 mg/l is extremely toxic to fresh-water fish. It has been recommended that public water supply sources be essentially free from oil and grease.

4.5.3 Ammonia (NH_3) and Ammonium (NH_4^+)

Ammonia is a non-conventional pollutant. It is a colourless gas with a very pungent odour, detectable at concentrations of 20 ppm in air by the nose, and is very soluble in water (570 gm/l at 25°C). Ammonia is produced industrially and also results from natural processes. Bacterial action on nitrates or nitrites, as well as dead plant and animal tissue, and animal wastes, produces ammonia. Typical domestic wastewaters contain 12 to 50 mg/l ammonia.

Ammonia is toxic to humans by inhalation of the gas or ingestion of aqueous solutions. The ionized form (NH_4^+) is less toxic than the un-ionized form. Ingestion of as little as one ounce of household ammonia has been reported as a fatal dose. Whether inhaled or ingested, ammonia acts destructively on mucous membrane with resulting loss of function. Aside from breaks in liquid ammonia refrigeration equipment, industrial hazard from ammonia exists where solutions of ammonium compounds may be accidentally treated with a strong alkali, releasing ammonia gas. As little as 150 ppm ammonia in air is reported to cause laryngeal spasm, and inhalation of 5000 ppm in air is considered sufficient to result in death.

The reported odour threshold for ammonia in water is 0.037 mg/l. Un-ionized ammonia is acutely or chronically toxic to many important freshwater and marine aquatic organisms at ambient water concentrations below 4.2 mg/l. Salmonid species are especially sensitive to the toxic effects of un-ionized ammonia at concentrations as low as 0.025 mg/l during prolonged exposure. Because the proportion of un-ionized ammonia varies with environmental conditions and cannot be directly controlled in the ambient water, total ammonia is the pollutant which must be controlled.

4.5.4 Total cyanide

Cyanides are among the most toxic of pollutants commonly observed in industrial wastewaters. Hydrogen cyanide (HCN), formed when the above salts are dissolved in water, is probably the most acutely lethal compound. The relationship of pH to hydrogen cyanide formation is very important. As pH is lowered to below 7, more than 99 percent of the cyanide is present as HCN and less than 1 percent as cyanide ions. Thus, at neutral pH, that of most living organisms, the more toxic form of cyanide prevails.

Cyanide ions combine with numerous heavy metal ions to form complexes. The complexes are in equilibrium with HCN. Thus, the stability of the metal-cyanide complex and the pH determine the concentration of HCN. Stability of the metal-cyanide anion complexes is extremely variable. Those formed with zinc, copper, and cadmium are not stable - they rapidly dissociate, with production of HCN, in near neutral or acid waters. Some of the complexes are extremely stable. Cobalt cyanide complexes are very resistant to acid distillation in the laboratory. Iron cyanide complexes are also stable, but undergo photodecomposition to give HCN upon exposure to sunlight. Synergistic effects have been demonstrated for the metal cyanide complexes making zinc, copper, and cadmium, cyanides more toxic than an equal concentration of sodium cyanide.

The toxic mechanism of cyanide is essentially an inhibition of oxygen metabolism, i.e., rendering the tissues incapable of exchanging oxygen. The cyanogen compounds are true noncummulative protoplasmic poisons. They arrest the activity of all forms of animal life. Cyanide shows a very specific type of toxic action. It inhibits the cytochrome oxidase system. This system is the one which facilitates electron transfer from reduced metabolites to molecular oxygen. The human body can convert cyanide to a nontoxic thiocyanate and eliminate it. However, if the quantity of cyanide ingested is too great at one time, the inhibition of oxygen utilization proves fatal before the detoxifying reaction reduces the cyanide concentration to a safe level.

Cyanides are more toxic to fish than to lower forms of aquatic organisms such as midge larvae, crustaceans, and mussels. Toxicity to fish is a function of chemical form and concentration, and is influenced by the rate of metabolism (temperature), the level of dissolved oxygen, and pH.

In laboratory studies, free cyanide concentrations ranging from 0.05 to 0.15 mg/l have been proven to be fatal to sensitive fish species including trout, bluegill, and fathead minnows. Levels above 0.2 mg/l are rapidly fatal to most fish species. Long term sublethal concentrations of cyanide as low as 0.01 mg/l have been shown to affect the ability of fish to function normally, e.g., reproduce, grow, and swim. Available data show that adverse effects on aquatic life occur at concentrations as low as 3.5×10^{-3} mg/l.

Persistence of cyanide in water is highly variable and depends upon the chemical form of cyanide in the water, the concentration of cyanide, and the nature of other constituents. Cyanide might be destroyed by strong oxidizing agents. Chlorine is commonly used to oxidize strong cyanide solutions. Carbon dioxide and nitrogen are the products of complete oxidation. But if the reaction is not complete, the very toxic compound, cyanogen chloride, may remain in the treatment system and subsequently be released to the environment.

At low concentrations and with acclimated microflora, cyanide may be decomposed by microorganisms in anaerobic and aerobic environments, or waste treatment systems.

4.5.5 Phenolic Compounds (4AAP)

"Phenolics" is a non-conventional pollutant parameter which is measured using the 4-AAP (4-aminoantipyrene) method. This analytical procedure measures the colour development of reaction products between 4-AAP and some phenols. The results are reported as "phenolics". Thus "phenolics" is not total phenols because many phenols (notably nitrophenols) do not react. Also, since each reacting phenol contributes to the colour development to a different degree, and each phenol has a molecular weight different from other and from phenol itself, analyses of several mixtures containing the same total concentration in mg/l of several phenols will give different numbers depending on the proportions in the particular mixture.

Despite these limitations of the analytical method, "phenolics" is a useful analysis when the mix of phenols is relatively constant and an inexpensive monitoring method is desired. In any given plant or even in an industry category, monitoring of "phenolics" provides an indication of the

concentration of this group of toxic pollutants as well as those phenols not selected as toxic pollutants. A further advantage is that the method is widely used in water quality determinations.

The phenolic compound hydroxybenzene or carbolic acid (phenol) contributes to the "phenolics" discussed above, which are determined by the 4-AAP colorimetric method. This phenol exhibits acute and sub-acute toxicity in humans and laboratory animals. Acute oral doses of phenol in humans cause sudden collapse and unconsciousness by its action of the central nervous system. Death occurs by respiratory arrest. Sub-acute oral doses in mammals are rapidly absorbed then quickly distributed to various organs, then cleared from the body by urinary excretion and metabolism. Long term exposure by drinking phenol contaminated water has resulted in statistically significant increases in reported cases of diarrhoea, mouth sores, and burning of the mouth. In laboratory animals, long term oral administration at low levels produced slight liver and kidney damage. No reports were found regarding carcinogenicity of phenol administered orally - all carcinogenicity studies were skin tests.

4.5.6 Benzene

Benzene (C_6H_6) is a clear, colourless, liquid obtained mainly from petroleum feedstocks by several different processes. Some is recovered from light oil obtained from coal carbonization gases. It boils at 80°C and has a vapour pressure of 100 mm Hg at 26°C. It is slightly soluble in water (1.8 g/l at 25 °C) and it dissolves in hydrocarbon solvents. Most of the benzene produced goes into chemical manufacture. About half of that is converted to ethylbenzene which is used to make styrene. Some benzene is used in motor fuels.

Benzene is harmful to human health, according to numerous published studies. Most studies relate effects of inhaled benzene vapours. These effects include nausea, loss of muscle coordination, and excitement, followed by depression and coma. Death is usually the result of respiratory or cardiac failure. Two specific blood disorders are related to benzene exposure. One of these, acute myelogenous leukaemia, represents a carcinogenic effect of benzene. However, most human exposure data are based on exposure in occupationed settings and benzene carcinogenesis is not considered to be firmly established. Oral administration of benzene to laboratory animals produced leucopenia, a reduction in number of leucocytes in the

blood. Subcutaneous injection of benzene-oil solutions has produced suggestive, but not conclusive, evidence of benzene carcinogenesis. Benzene demonstrated teratogenic effects in laboratory animals, and mutagenic effects in humans and other animals.

4.5.7 Benzo(a)pyrene

Benzo(a)pyrene has been selected as representative of polynuclear aromatic hydrocarbons (PAH's) which are a group of 13 compounds consisting of substituted and unsubstituted polycyclic aromatic rings. PAH's are formed as the result of incomplete combustion when organic compounds are burned with insufficient oxygen. PAH's are found in coke oven emissions, vehicular emissions, and volatile products of oil and gas burning.

Several of the PAH toxic pollutants are found in smoked meats, in smoke flavouring mixtures, in vegetable oils, and in coffee. They are found in soils and sediments in river beds; consequently, they are also found in many drinking water supplies. The wide distribution of these pollutants in complex mixtures with the many other PAHs which have not been designated as toxic pollutants results in exposures by humans that cannot be associated with specific individual compounds. Air pollution studies indicate an excess of lung cancer mortality among workers exposed to large amounts of PAH containing materials such as coal gas, tars, and coke-oven emissions.

Animal studies have demonstrated the toxicity of PAH by oral and dermal administration. The carcinogenicity of PAH's has been traced to formation of PAH metabolites which, in turn, lead to tumour formation. Because the levels of PAH which induce cancer are very low, little work has been done on other health hazards resulting from exposure. It has been established in animal studies that tissue damage and systemic toxicity can result from exposure to noncarcinogenic PAH compounds.

4.5.8 Naphthalene

Naphthalene is an aromatic hydrocarbon with two orthocondensed benzene rings and a molecular formula of $C_{10}H_8$. As such it is also representative of PAH's. Pure naphthalene is a white crystalline solid melting at 80°C. For a solid, it has a relatively high vapour pressure (0.05

mm Hg at 20°C), and moderate water solubility ((19 mg/l at 20°C). Naphthalene is the most abundant single component of coal tar. About three fourths of production is used as feedstock for phthalic anhydride manufacture. Most of the remaining production goes into manufacture of insecticide, dystuffs, pigments, and pharmaceuticals. Chlorinated and partially hydrogenated naphthalenes are used in some solvent mixtures. Naphthalene is also used as a moth repellent.

Naphthalene, ingested by humans, has reportedly caused vision loss (cataracts), hemolytic anemia, and occasionally, renal disease. These effects of naphthalene ingestion are confirmed by studies on laboratory animals. No carcinogenicity studies are available which can be used to demonstrate carcinogenic activity for naphthalene. Naphthalene does bioconcentrate in aquatic organisms. Available data show that adverse effects on aquatic life occur at concentrations as low as 0.62 mg/l.

4.5.9 Lead

Lead is a soft, malleable, ductile, blueish-gray, metallic element, usually obtained from the mineral galena (lead sulphide, PbS), anglesite (lead sulphate, $PbSO_4$), or cerussite (lead carbonate, $PbCO_3$). Because it is usually associated with minerals of zinc, silver, copper, gold, cadmium, antimony, and arsenic, special purification methods are frequently used before and after extraction of the metal from the ore concentrate by smelting.

Lead is widely used for its corrosion resistance, sound and vibration absorption, low melting point (solders), and relatively high imperviousness to various forms of radiation. Small amounts of copper, antimony and other metals can be alloyed with lead to achieve greater hardness, stiffness, or corrosion resistance than is afforded by the pure metal. Lead compounds are used in glazes and paints. The largest use is for storage batteries.

Lead ingested by humans produces a variety of toxic effects including impaired reproductive ability, disturbances in blood chemistry, neurological disorders, kidney damage, and adverse cardiovascular effects. Exposure to lead in the diet results in permanent increase in lead levels in the body. Most of the lead entering the body eventually become localized in the bones where

it accumulates. Lead is a carcinogen or cocarcinogen in some species of experimental animals. Lead is teratogenic in experimental animals. Mutagenicity data are not available for lead.

4.5.10 Zinc

Zinc occurs abundantly in the earth's crust, concentrated in ores. It is readily refined into the pure, stable, silvery-white metal. In addition to its use in alloys, zinc is used as protective coating on steel. It is applied by hot dipping (i.e. dipping the steel in molten zinc) or by electroplating.

Zinc can have an adverse effect on man and animals at high concentrations. Zinc at concentrations in excess of 5 mg/l causes an undesirable taste and odour which persists through conventional treatment.

Toxic concentrations of zinc compounds cause adverse changes in the morphology and physiology of fish. Lethal concentrations in the range of 0.1 mg/l have been reported. Acutely toxic concentrations induce cellular breakdown of the gills, and possibly the clogging of the gills with mucous. Chronically toxic concentrations of zinc compounds cause general enfeeblement and widespread histological changes to many organs, but not to gills. Abnormal swimming behaviour has been reported at 0.04 mg/l. Growth and maturation are retarded by zinc. It has been observed that the effects of zinc poisoning may not become apparent immediately so that fish removed from zinc-contaminated water may die as long as 48 hours after removal.

In general, salmonids are most sensitive to elemental zinc in soft water; the rainbow trout is the most sensitive in hard waters. A complex relationship exists between zinc concentration, dissolved zinc concentration, temperature, and calcium and magnesium concentration. Prediction of harmful effects has been less than reliable and controlled studies have not been extensively documented.

The major concern with zinc compounds in marine waters is not with acute lethal effects, but rather with the long-term sublethal effects of the metallic compounds and complexes. Zinc accumulates in some marine species, and marine animals contain zinc in the range of 6 to 1500

mg/kg. From the point of view of acute lethal effects, invertebrate marine animals seem to be the most sensitive organism tested.

Toxicities of zinc in nutrient solutions have been demonstrated for number of plants. A variety of fresh water plants tested manifested harmful symptoms at concentrations of 10 mg/l. Zinc sulfate has also been found to be lethal to many plants.

In slug doses, and particularly in the presence of copper, dissolved zinc can interfere with or seriously disrupt the operation of biological processes by reducing overall removal efficiencies, largely as a result of the toxicity of the metal to biological organiser. However, zinc solids in the form of hydroxides or sulfides to not appear to interfere with biological treatment processes, on the basis of available data. Such solids accumulate in the sludge.

4.5.11 Chromium

Chromium is an elemental metal usually found as a chromate ($FeO \cdot Cr_2O_3$). A significant proportion of the chromium used is in the form of compounds such as sodium dichromate (Na_2CrO_4), and chromic acid (CrO_3) - both are hexavalent chromium compounds.

Chromium is found as an alloying component of may steels and its compounds are used in electroplating baths, and as corrosion inhibitors for closed water circulation systems.

The two chromium forms most frequently found in industry wastewaters are hexavalent and trivalent chromium. Hexavalent chromium is the form used for metal treatments. Some of it is reduced to trivalent chromium as part of the process reaction. The raw wastewater containing both valence states is usually treated first to reduce remaining hexavalent to trivalent chromium, and second to precipitate the trivalent form as the hydroxide. The hexavalent form is not removed by lime treatment.

Chromium, in its various valence states, is hazardous to man. It can produce lung tumours when inhaled, and induces skin sensitizations. Large doses of chromates have corrosive effects

on the intestinal tract and can cause inflammation of the kidneys. Hexavalent chromium is a known human carcinogen.

The toxicity of chromium salts to fish and other aquatic life varies widely with the species, temperature, sensitization, valence of the chromium, and synergistic or antagonistic effects, especially the effect of water hardness. Studies have shown that trivalent chromium is more toxic to fish of some types than is hexavalent chromium. Fish food organisms and other lower forms of aquatic life are extremely sensitive to chromium. Therefore, both hexavalent and trivalent chromium must be considered harmful to particular fish organisms.

4.5.12 Cadmium

Cadmium is a relatively rare metallic element that is seldom found in sufficient quantities in a pure state to warrant mining or extraction from the earth's surface. It is found in trace amounts of about 1 ppm throughout the earth's crust. Cadmium is, however, a valuable by-product of zinc production.

Cadmium is used primarily as an electroplated metal, and is found as an impurity in the secondary refining of zinc, lead, and copper.

Cadmium is an extremely dangerous cumulative toxicant, causing progressive chronic poisoning in mammals, fish, and probably other organisms. The metal is not excreted.

Cadmium might be a factor in the development of such human pathological conditions as kidney disease, testicular tumours, hypertension, arteriosclerosis, growth inhibition, chronic disease of old age, and cancer. Cadmium is normally ingested by humans through food and water as well as by breathing air contaminated by cadmium dust. Cadmium is cumulative in the liver, kidney, pancreas, and syndrome known as itai-itai disease has been documented in Japan as caused by cadmium ingestion via drinking water and contaminated irrigation water. Ingestion of as little as 0.6 mg/day has produced the disease. Cadmium acts synergistically with other metals. Copper and zinc substantially increase its toxicity.

Cadmium is concentrated by marine organisms, particularly mollusks, which accumulate cadmium in calcareous tissues and in the viscera. A concentration factor of 1000 for cadmium in fish muscle has been reported, as have concentration factors of 3000 in marine plants and up to 29,600 in certain marine animals. The eggs and larvae of fish are apparently more sensitive than adult fish to poisoning by cadmium, and crustaceans appear to be more sensitive than fish eggs and larvae.

4.5.13 Nickel

Nickel is seldom found in nature as the pure elemental metal. It is a relatively plentiful element and is found in the oceans. The chief commercial ores for nickel are pentlandite $\{(Fe, Ni)_9S_8\}$, and a lateritic ore consisting of hydrated nickel-iron-magnesium silicate. Nickel has many and varied uses. It is used in alloys and as the pure metal. Nickel salts are used for electroplating baths.

The toxicity of nickel to man is thought to be very low, and systemic poisoning of human beings by nickel or nickel salts is almost unknown. In nonhuman mammals nickel acts to inhibit insulin release, depress growth, and reduce cholesterol. A high incidence of cancer of the lung and nose has been reported in humans engaged in the refining of nickel.

Nickel salts can kill fish at very low concentrations. However, nickel has been found to be less toxic to some fish than copper, zinc and iron. Nickel is present in coastal and open ocean water at concentrations in the range of 0.0001 to 0.006 mg/l, although the most common values are 0.002 - 0.003 mg/l. Marine animals contain up to 0.4 mg/l and marine plants contain up to 3 mg/l. Higher nickel concentrations have been reported to cause reduction in photosynthetic activity of the giant kelp. A low concentration was found to kill oyster eggs.

Nickel is found in nearly all soils, plants, and waters. In soils, nickel typically is found in the range from 10 to 100 mg/kg. Various environmental exposures to nickel appear to correlate with increased incidence of tumours in man.

Nickel toxicity may develop in plants from application of sewage sludge on acid soils. Nickel has caused reduction of yields for a variety of crops including oats, mustard, turnips, and cabbage. In one study nickel decreased the yields of oats significantly at 100 mg/kg. Whether nickel exerts a toxic effect on plants depends on several soil factors, the amount of nickel applied, and the contents of other metals in the sludge. Unlike copper and zinc, which are more available from inorganic sources than from sludge, nickel uptake by plants seems to be promoted by the presence of the organic matter in sludge. Soil treatments, such as liming reduce the solubility of nickel. Toxicity of nickel to plants is enhanced in acidic soils.

4.5.14 pH

Although not a specific pollutant, pH is related to the acidity or alkalinity of a wastewater stream. The term pH is used to describe the hydrogen ion concentration (or activity) present in a given solution. Values for pH range from 0 to 14, and these numbers are the negative logarithms of the hydrogen ion concentrations. A pH of 7 indicates neutrality. Solutions with a pH above 7 are alkaline, while those solutions with a pH below 7 are acidic. The relationship of pH to acidity and alkalinity is not necessarily linear or direct. Knowledge of the pH of water is useful in determining necessary measures for corrosion control, sanitation, and disinfection. Its value is also necessary in the treatment of industrial wastewaters to determine amounts of chemicals required to remove pollutants and to measure their effectiveness. Removal of pollutants, especially dissolved metals is affected by the pH of the wastewater.

Waters with a pH below 6.0 are corrosive to water works structures, distribution lines, and household plumbing fixtures and can thus add constituents to drinking water such as iron, copper, zinc, cadmium, and lead. The hydrogen ion concentration can affect the taste of the water and at a low pH, water tastes sour. The bactericidal effect of chlorine is weakened as the pH increases, and it is advantageous to keep the pH close to 7.0. This is significant for providing safe drinking water.

Extremes of pH or rapid pH changes can exert stress conditions or kill aquatic life outright. Even moderate changes from acceptable criteria limits of pH are deleterious to some species. The relative toxicity to aquatic life of many materials is increased by changes in the pH of the water.

For example, metallocyanide complexes can increase a thousand-fold in toxicity with a drop of 1.5 pH units.

Because of the universal nature of pH and its effect on water quality and treatment, it is selected as a pollutant parameter for many industry categories. A neutral pH range (approximately 6-9) is generally desired because either extreme beyond this range has a deleterious effect on receiving waters or the pollutant nature of other wastewater constituents.

4.5.15 Toxicity

An effluent is said to have failed the Ontario toxicity test if it is found to be lethal to over 50% of a test population of either rainbow trout (Salmo Gairdneri) or Daphnia Magna after exposure to 100% effluent for 96 hours (Rainbow Trout Protocol), or 48 hours (Daphnia Magna Protocol).

4.6 Toxicity of Selected Contaminant Parameters

For the 14 key contaminant parameters selected for this study, toxicity data were compiled and are shown in Table 4.7: *Toxicity Data and Water Quality Objectives*. As described previously in section 3.9.3, the sources of these data were diverse, providing both acute LC50 toxicity values, as well as an example of some current water quality criteria.

For many of these parameters, toxicity is a function of other environmental conditions. For example, the toxicity of ammonia/ammonium is dependent upon pH and temperature, while the effects of lead, zinc, chromium, cadmium and nickel are all functions of hardness. As well, despite standardization of toxicity test protocols by the MOE, available toxicity data has been acquired through a variety of experimental conditions (fish size, fish lifestage, pH, hardness). Therefore, while the table may report LC50 values as either a range or as a single number value, the nature of the test is such that statistical variability can arise through both random and procedural variation, not to mention the possibility of discrepancies between in vivo and in vitro observations.

TABLE 4.7: TOXICITY DATA AND WATER QUALITY OBJECTIVES

	ACUTE 96-h LC50 VALUES (1)					
PARAMETER	PROVIDED BY MOE (2)	ONTARIO WORKING DATA (3) (mg/L)	US EPA (4) (mg/L)	US EPA FWQC (5) (mg/L)	PWQO/G BLUE BOOK (6) (mg/L)	REVISED PWQO/G (7) (mg/L)
TSS	n/a	n/a	n/a	n/a	10% (Secchi)	n/a
oil and grease	n/a	n/a	n/a	n/a	n/a	n/a
ammonia + ammonium (8)	n/a	0.16-0.77 (un-ionized)	0.16-1.1	0.47 @ pH8 and 30C	0.02 (un-ionized)	n/a
total cyanide	0.022	0.027	0.045 (free)	0.022 (free)	0.005 (free)	n/a
phenolics	n/a	(phenol) 5.0-11.6	(phenol) 28.5(9)	n/a	0.001	n/a (12)
lead (10)	1.47	1.17-1.47	2.448	0.025-0.160	0.005-0.025	0.001-0.005
zinc (10)	0.066	0.066-2.96	0.09-7.21	0.180-0.570	0.030	0.016
benzene	n/a	5.3-21.6	5.3	n/a	0.27(11)	0.1
benzo(a)pyrene	n/a	0.006(9)	n/a	n/a	0.0003(11)	0.00000006
naphthalene	n/a	1.6	n/a	n/a	n/a	n/a
chromium (10)	3.4	(III) 4.4	(III) 4.4-24.1	(III) 0.870-2.70	0.100	n/a
hex. chromium (10)	n/a	3.4-65.5	69	0.011	0.17(11)	n/a
cadmium (10)	0.0039	0.0023-2.6	0.0036	0.0007-0.002	0.0002	0.0001-0.0005
nickel (10)	2.5	8.9-10.0	n/a	1.1-3.1	0.025	n/a

(1) LC50 values are for Rainbow Trout (Salmo gairdneri).

(2) Data obtained from the Ontario Ministry of the Environment.

(3) Data are from Draft Provincial Water Quality Objective/Guideline Development Documents and MOE Water Resources Branch communication. Ranges reflect experimental variation.

(4) US EPA Ambient Water Quality Criteria Document values, as reviewed in the Canadian Water Quality Guidelines.

(5) US EPA Federal Water Quality Criteria. Max. conc. for freshwater aquatic life from the EPA Federal Register, 45, November 28, 1980, 79318-41, and EPA Federal Register, 49(26), February 7, 1984, 4551-54. Maximum not to be exceeded values. Ranges are for hardness levels of 50 -200 mg/L as CaCO3.

(6) Provincial Water Quality Objectives/Guidelines, Ontario Ministry of the Environment, 1984.

(7) Revised values approved by the Ontario Aquatic Criteria Development Committee. Data are unpublished but available upon request.

(8) Reported values are functions of pH and Temperature.

(9) For Fathead Minnow.

(10) Reported values are functions of hardness.

(11) 5% of LC50 value as recommended by the PWQO/G Blue Book as a max. 1-day average for unspecified non-persistent toxic substances.

(12) Future guidelines will be for individual phenol compounds.

Files: TOXTAB2.WK1 and TOXTAB2.ALL

5.0 MODEL BAT TECHNOLOGIES AND EFFLUENT CHARACTERISTICS

5.1 Methodology for Selection of BAT Technology

5.1.1 Introduction

Five Model Best Available Technologies (BAT's) were developed for the various categories in the Iron and Steel Sector in Ontario. These five Models were:

BAT #1	Best in Ontario
BAT #2	Best in the USA
BAT #3	Best at Selected World Locations
BAT #4	Non-Lethal (passes Ontario Toxicity Test)
BAT #5	Virtual Elimination of Persistent Toxics

The selected world locations were Canada, the United States, Germany, Holland, Japan and South Korea.

As is noted in Section 1.3, the first step which was followed in developing the Model BAT's was sub-sectoring the Ontario Iron and Steel Sector into integrated and non-integrated mills (specialty and mini mills). Then the following general approach was taken to develop BAT's for each of the above Models:

BAT #1 evaluation of MISA monitoring data to determine the best performing mills in Ontario;

BAT #2 identification of the best mills in the United States that are similar to or contain the same production processes as the Ontario Mills;

BAT #3 evaluation of wastewater treatment at selected mills in Germany, Holland, Japan, and South Korea and the best technologies in the USA and Canada to identify the "best in the world".

BAT #4 evaluation of long term monitoring data for the mill identified as Best in the World under BAT #3 to assess whether effluent will be lethal or non-lethal; and whether treatment technologies exist to further reduce contaminant levels to ensure a non-lethal effluent.

BAT #5 evaluation of long term monitoring data for the BAT #3 mill to assess whether virtual elimination had been achieved, or to assess further treatment to achieve virtual elimination.

In order to compare performance of mills with different production rates (i.e., size), it was necessary to normalize effluent discharge loadings of pollutants using production. Thus, consistent with the MISA goal of virtual elimination, the Model BAT's focus on those mills with the lowest mass discharge of pollutants expressed in grams per tonne of production. Accordingly, efficient utilization of process water through in-plant reuse and recycle, and end-of-pipe treatment and recycle were generally preferred. Table 5.1.1, entitled *Comparison of Typical Water Consumption Rates at Various Facilities* illustrates the range of water usage at some mills.

The two key components of calculating the grams/tonne discharged are reliable effluent monitoring data and reliable production data. The effluent monitoring data is provided under the MISA monitoring program via the MIDES data base. Detailed Production data for the MISA period was provided by each of the Ontario mills. This permitted calculation of grams per tonne discharged.

The definition of Virtual Elimination is unresolved at this time. Possible definitions (MISA Issues Report) are as follows:

- pollutant concentration < RMDL
- pollutant concentration < PWQO
- persistent bioaccumulative toxics concentration <RMDL, concentration of all other toxics <PWQO.

For the purpose of this study, BAT #5 has defined virtual elimination to mean no discharge of process wastewater effluent, with little or no inter-media transfer, wherever persistent toxics are contained in the wastewater above RMDL concentrations.

When defining Model BAT's, the technologies were considered to be demonstrated and appropriate for use as best available technologies if the following criteria were met:

- There were sufficient long term data available to characterize the performance of the technology.

- - The technology was demonstrated and in use for at least one year on a full scale basis within the sector for the particular application; or

  - The technology was tested on a pilot scale basis within the sector and sufficient data were obtained to permit design scale up and costing; or

  - The technology is not currently used within the sector, but is well demonstrated within other sectors and is transferable to the application within the Iron and Steel sector.

Aside from the "no discharge to receiving waters" technologies which were selected for some Model BAT #4 and #5, all Model BAT's are based upon existing treatment technologies demonstrated within the Iron and Steel Sector.

TABLE 5.1.1: COMPARISON OF TYPICAL WATER CONSUMPTION RATES AT VARIOUS FACILITIES

PROCESS/LOCATION	USGAL/TON	M3/TONNE	REMARKS
COKEMAKING			
US EPA BAT	153	0.64	Incl. 50 USGPM dilution water.
Inland Steel	129	0.54	No NH3 or light oil recovery.
Stelco – L.E.W.	144	0.60	
Dofasco	170	0.71	
USS – Clairton	207	0.86	Dilution allowance used.
Stelco – Hilton	438	1.8	Coke Side Shed emissions only.
Algoma (MIDES #1400 + #1600)	706	2.9	Not incl. Coke Quench WW.
SINTERING (wet)			
US EPA BAT	120	0.50	
USS – Gary Works	2.2	0.0091	Slag quench.
BSCO – SP	110	0.46	
Stelco – Hilton	1914	8.0	
BLAST FURNACES			
US EPA BAT	70	0.29	
Inland Steel No. 7	0	0	Slag quench
USS – Gary Works	3.6	0.015	Slag quench
USS/KOBE Steel	7.4	0.031	Slag quench
LTV – Cleveland	10	0.042	Slag quench
WPSC – MJ	19	0.079	
BSCO – BH	22	0.092	Slag quench
Dofasco	36	0.15	Not incl. Ladle Cleaning WW
WPSC – S	46	0.19	
BSCO – SP	62	0.26	
Stelco – L.E.W.	189	0.79	Slag quench 0.08 m3/tonne excl..
Stelco – Hilton	317	1.3	
Algoma	1972	8.2	

Files: watconsm.wk1 and watconsm.all

TABLE 5.1.1: COMPARISON OF TYPICAL WATER CONSUMPTION RATES AT VARIOUS FACILITIES (continued)

PROCESS/LOCATION	USGAL/TON	M3/TONNE	REMARKS
STEELMAKING – BOF (wet)			
US EPA BAT (SC/OC)	50/110	0.21/0.46	
Stelco – Hilton	0	0	OC, Dry Gas Cleaning
LTV – Cleveland	<0.5	<0.002	SC, Intermittent discharge
USS/KOBE Steel	14	0.058	SC
BSCO – BH	18	0.075	OC/SC
Inland Steel No. 4	58	0.24	OC
WPSC – MJ	137	0.57	OC
Stelco – L.E.W.	264	1.1	SC
Algoma	568	2.4	OC
Dofasco	2037	8.5	No. 1 MS OC, No. 2 MS SC
CONTINUOUS CASTERS			
US EPA BAT	25.0	0.10	
USS Gary No. 2	<8.9	<0.037	Slab
Inland Steel No. 2	18	0.075	Slab
Inland Steel No. 1	20	0.083	Slab
BSCO – BH No. 1	24	0.10	Slab
USS/KOBE Steel	27	0.11	Billet
Dofasco	70	0.29	Slab
Stelco – L.E.W.	335	1.4	Slab
Stelco – Hilton	1493	6.2	
Algoma	1777	7.4	
HOT FORMING			
US EPA BPT	600 – 2560	2.5 – 11	65% recycle of applied flows.
US NSPS	60 – 260	0.25 – 1.1	96% recycle of applied flows.
LTV – Cleveland	69	0.29	Hot Strip
USS – Gary Works	86	0.36	Hot Strip
Stelco L.E.W.	204	0.85	Hot Strip
Dofasco No. 2 HM	311	1.3	Hot Strip
Algoma No. 2 TM	1054	4.4	Pipe & Tube
Dofasco No. 1 HM	4049	17	
Stelco Hilton #2 Rod Mill	5223	22	
Stelco Hilton	5812	24	
Algoma No. 1 TM	7035	29	
Algoma	11357	47	Main Filter Plant
Stelco Hilton #3 B&B	26332	110	Includes NCCW

Files: watconsm.wk1 and watconsm.all

5.1.2 Model BAT #1 Best in Ontario - Integrated Mills

Integrated mills are those that produce finished and semi-finished steel products from coal, limestone and iron-bearing materials (iron ores and beneficiated iron ores). As noted in Section 1.3, the following major process categories were selected:

- Cokemaking
- Sintering
- Ironmaking
- Steelmaking
- Continuous Casting
- Hot Forming
- Finishing

Process (direct contact) wastewaters are generated in each of these operations. Other discharges include non-contact cooling water (NCCW) which may be recycled or discharged on a once-through basis, and storm water runoff. For purposes of this project, the integrated mills were categorized into individual processes as set out above. Non-contact cooling water, utilities wastewater and storm water were considered separately. Integrated mills with and without finishing were also considered as two separate categories.

Stelco Lake Erie Works effluent data from MISA Point 0400 (process effluent) was disaggregated to each production category by Hatch and LEW staff. The basis for disaggregation is shown in Table 5.1.2.

Following is a review of the selection of the Model BAT #1 selections for integrated mills.

TABLE 5.1.2: DISAGGREGATION OF STELCO LEW MISA POINT 0400 DATA (Note 1)

PARAMETERS	ACTUAL MISA 0400 (Note 2)	DISAGGREGATION BASED ON PERCENT OF ACTUAL							
		Coke Oven	BF	BOF	RHOB	Cont. Caster	Hot Strip Mill	Central Power	SECW (Note 3)
	(m3/day)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
Flow	19607	4.9	14.6	24.4	2.44	29.3	14.6	7.3	2.44
	(kg/day)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
TSS	95.602	7.34	14.6	24.4	2.44	29.3	14.6	7.3	-
oil and grease	27.549	5	-	-	-	30	65	-	-
ammonia + ammonium	1.653	10	90	-	-	-	-	-	-
total cyanide	2.232	40	60	-	-	-	-	-	-
phenolics	0.047	25	75	-	-	-	-		-
lead	0.633	-	10	70	20	-	-	-	-
zinc	1.275	-	10	70	20	-	-	-	-
benzene	0.005	100	-	-	-	-	-	-	-
benzo(a)pyrene	0.010	100	-	-	-	-	-	-	-
naphthalene	0.006	100	-	-	-	-	-	-	-

Notes: 1. This disaggregation was provided by Stelco LEW.
2. MISA Monitoring Point 0400 at Stelco LEW is located at the exit of the Blowdown Treatment Plant.
3. SECW = Secondary Exchange Cooling Water

Files: DIS0400.WK1 and DIS0400.ALL

Cokemaking

Coke is produced at all of the four integrated mills - Algoma, Dofasco, Stelco Hilton and Stelco LEW.

Algoma treats its cokemaking wastewater in ammonia stills (fixed leg only) and a dephenolizer. A fluidized bed biological treatment plant, similar to that installed at Hoogovens in Holland is installed on site but not started up at this time.

Dofasco cokemaking effluent treatment consists of free and fixed leg ammonia stills followed by a biological treatment plant consisting of an aeration section followed by a secondary clarifier. The treatment plant appears to be overloaded, and waste activated sludge is discharged to the Hamilton-Wentworth Municipal Sewage Treatment Plant. The plant operation (maintenance of MLVSS or F/M ratios, or SRT) does not appear to be optimized. Effluent from the final clarifier goes to the Bay without tertiary treatment.

Stelco Hilton cokemaking effluents are treated by free and fixed leg ammonia stills. The ammonia still bottoms are discharged to the Hamilton-Wentworth Municipal Sewage Treatment Plant.

Stelco Lake Erie Works cokemaking wastewater treatment includes collection of contaminated run-off from the coke plant area, collection in an equalization tank, ammonia stripping in stills (fixed and free leg), primary clarifier (not currently used since fixed leg of ammonia still was converted to caustic from lime), aeration basins (2), secondary clarifier, and excess sludge thickening and disposal to coal feed. The effluent from this system is discharged to the Blowdown Treatment Plant, where pH adjustment for dissolved metals precipitation followed by chlorine addition to achieve cyanide breakdown and break point chlorination to achieve residual ammonia breakdown is practised. The biotreatment plant is well operated and has been modified and optimized from its original design basis.

Stelco LEW was selected as BAT #1 Best in Ontario based on effluent quality.

Ironmaking

Ironmaking at Algoma is carried out in two blast furnaces No. 6 and No. 7. Offgases from the blast furnaces are cleaned by Venturi Scrubbers, and scrubber effluent is discharged to Thickener No. 2 for suspended solids reduction prior to discharge. No recycle is practised.

Dofasco implemented a new blast furnace gas washing water recycling system for its four blast furnaces during the MISA monitoring period. The system consists of a thickener with sludge management system, cooling tower and recycle pumps. Blowdown is filtered by a Dynasand filter prior to discharge.

Stelco Hilton has two blast furnace operations, furnace "D" and "E". Both furnaces are served by wet gas cleaning systems, which incorporate thickeners and coolers (E) or a cooling Tower (D), and recycle pumps. Gas cleaning water from the blast furnace, and make-up and blowdown are maintained to permit cascade to the sinter plant where it is used on a once-through basis prior to discharge to the East Side Filtration Plant. Both D and E furnace thickener discharge to a sludge thickener after which sludge is dewatered and conveyed to the sinter plant as feed. Because of the cascaded use of the water, no specific data is available for iron making.

Stelco LEW has one blast furnace equipped with a Bischoff scrubber for gas cleaning. Scrubber water is discharged to a thickener then to a cooling tower and then recycled to the furnace scrubber. Sludge from the thickener is dewatered and stored on site for future recovery of its iron value. The recycle system achieves 94% recycle. Blowdown from this system is sent to the Blowdown Treatment Plant for further reduction in suspended solids, ammonia and cyanide.

Stelco LEW on the basis of emissions per tonne was selected as BAT #1.

Steelmaking

Steel is produced at Algoma from No. 1 and No. 2 Basic Oxygen Steel Plants by the open hood or full combustion method. A more detailed review of the differences between open hood or full combustion systems and closed hood or suppressed combustion systems is given in Section 5.5.1. Gas cleaning wastewater from both BOSPS is discharged to No. 1 thickener for

suspended solids reduction prior to discharge to the St. Mary's River via the Bar and Strip lagoon. No recycle is practised.

Dofasco has two steel production shops - No. 1 contains No. 1, 2, and 3 Basic Oxygen Furnaces (BOFs) and No. 2 contains No. 4 BOF. No. 1 Melt Shop is open combustion, No. 2 is suppressed. All wastewater from the gas cleaning scrubbers is pumped to the BOF thickener for suspended solids reduction. From here it is discharged without recycle or further treatment.

Stelco Hilton produces steel at 3 BOFs numbers 4, 5, and 6. All gas cleaning is done by a dry process. All BOFs are open combustion. There is no direct process water associated with Stelco Hilton's Steelmaking operations.

Stelco LEW produces steel in a two vessel suppressed combustion BOF. Gas cleaning scrubber water is passed through cyclone separators then to a gravity thickener prior to recycle. The recycle system receives blowdown from the Hot Strip Mill recycle system and the Vacuum Degasser as make up to the BOF gas cleaning water. Blowdown form the BOF goes to the Blowdown Treatment Plant where it receives further treatment for suspended solids removal and metals removal.

For BAT #1, for open combustion systems Stelco Hilton with no process wastewater is selected. For BAT #1 for suppressed combustion systems Stelco LEW is selected on the basis of lowest emissions.

Sintering

Only one of the integrated mills in Ontario has sinter plant production - Stelco Hilton.

Sintering is also carried out at Wawa for Algoma's operations but this facility is not part of this industrial sector.

Wastewater from ironmaking gas cleaning operations is fed to the Stelco Hilton sinter plant. This water is used on a once-through basis and then discharged to the East Side Filtration Plant.

In accordance with the MISA Issues Resolution Recommendations, Sintering is not further reviewed as a separate category for BAT purposes since there is only one plant in Ontario, and at that plant the wastewater is integrated with Ironmaking.

Vacuum Degassing

Of the four integrated mills in Ontario, only two, Dofasco and Stelco LEW utilise vacuum degassing in their production process.

At Dofasco's No. 2 Melt Shop (No. 4 BOF) ladle metallurgy and ladle degassing operations are performed. The condenser blowdown discharges into the No. 1 caster scale pit and then to the No. 2 Hot Mill Filter Plant. No effluent data is available.

At Stelco LEW an RHOB vacuum degasser system is employed on about 70% of the Steel output. The intercondenser water is recirculated and the blowdown is discharged to the BOF gas cleaning system. Estimated disaggregated data is available only.

After a review of the available data, the limited applicability of this process in Ontario, and the recognition that the process water is cascaded to other processes, this operation was not further pursued as a separate process category. However, the discharges are included in the review of integrated mills including and excluding finishing.

Continuous Casting

Algoma has two casting plants, No. 1 fed by No. 1 BOF and No. 2 slab caster fed by the No. 2 BOF. The round caster plant construction has been halted and is not yet started up. Once through contact cooling water from No. 1 plant goes to the Bar and Strip Lagoon and is then discharged to the River. Once through slab caster contact cooling water goes to the main filter plant prior to discharge. No data is available (except flows) relating to casting as a separate production process.

Dofasco No. 2 Hot Mill filtration plant receives wastewater from the No. 1 caster and No. 1 Hot Strip Mill. The treatment system consists of large scale pits, settling basis, sand filters, cooling towers and recycle pumps. The system achieves 97% recycle. Backwash from the filters is sent

to decant basins. No effluent quality data is available for the Continuous Caster operations as these are integrated with the Hot Strip Mill. No. 1 Hot Strip mill and caster have similar treatment plant except for the cooling towers: This effectively limits the recycle capability to about 30% of process flow.

There are two continuous casting machines at Stelco Hilton. The No. 1 caster produces blooms and slabs, and the No. 2 machine is a slab caster. Mould and machine cooling water systems are closed loop. Some recycle of contact cooling water is practised from the caster scale pits. The blowdown from the caster scale pits goes to East Side Filtration Plant prior to discharge.

Stelco LEW has a continuous slab caster. Contact cooling water is conveyed to a scale pit, followed by sand filters and a cooling tower and then recycle to the caster. Blowdown consists of filter back wash which is directed to the BOF pumphouse dirty water sump, and ultimately to the Blowdown Treatment Plant for treatment.

Both Dofasco and Stelco LEW employ modern recycle systems for caster contact cooling water. Stelco LEW is selected as BAT #1 since some effluent quality data is available and the filter back wash (which is the system blowdown) is treated additionally in the Blowdown Treatment Plant. Dofasco's No. 2 HMFP may well be similar to this system in contaminants discharged, but no specific data is available.

Hot Forming

All integrated mills in Ontario have hot forming operations ranging from strip to structural to tubes.

Algoma central hot forming mills manufacture blooms, slabs, rails, and hot strip. Contact cooling water is discharged to scale pits and sometimes limited recycle is operated. Wastewater is conveyed to the main filter plant where it is treated for solids and oil removal and then discharged to the River. The tube mills - No. 1 and No. 2 are located to the other side of Davignon Creek. No. 2 Seamless Tube mill is equipped with scale pit, sand filters, cooling tower and achieves a high rate recycle. The blowdown from this system is comparable with other high

recycle systems at 0.96m^3/tonne. No. 1 Tube Mill is a once through system without filtration. However, this mill saw little production during the MISA period.

Dofasco's No. 1 and No. 2 Hot Strip Mills are both integrated with the respective caster cooling water systems and are covered in the previous section. Dofasco's No. 2 Hot Mill is comparable to other high rate recycle systems at 1.22 m^3/tonne.

Stelco Hilton central hot forming operations consist of the Universal Slabing Mill, 148" Plate Mill, Hot Strip Mill and No. 1 Bar Mill. Local recycle is practised at the Universal Slabbing Mill (scale pit and cooling tower), 148" Plate Mill (Scale pit), and No. 1 Bar Mill (circular scale pit). Blowdowns from these local recycles and once through flows from the Hot Strip Mill are sent to the East Side Filtration Plant prior to discharge. The No. 3 Bloom and Billet Mill, also located in the main plant area, has a scale pit and filter system and recycles about 50% wastewater. Blowdown is discharged to the North outfall. No. 2 Rod mill is located at a site about 1 mile away from the main Hilton works complex. Once through contact cooling water is treated in a scale pit and lagoon prior to discharge.

Stelco LEW's Hot Strip Mill contact cooling water flows to a large lagoon where oil is removed and gross solids deposited. From there the water is filtered in sand filters and cooled prior to recirculation. This system achieves a blowdown of 0.85 m^3/tonne. The blowdown from the system is the filter back wash which is decanted and the underflow conveyed to the BOF gas cleaning system. Disaggregated effluent data indicates that effluent characteristics are comparable with Dofasco No. 2 Hot Mill and Algoma No. 2 Tube Mill.

Stelco LEW Hot Strip Mill is selected as BAT #1 as it has the lowest flow per tonne, and the blowdown wastewater is treated for metals and suspended solids removed in the Blowdown Treatment Plant. However, Dofasco and Algoma employ closely comparable systems.

Finishing

Algoma's Finishing production is located at the cold mill. Processes consist of acid pickling, reduction mill and temper mill. Waste pickle liquor is 40% sold to other users, 60% disposed of to slag dump. Acidic rinse waters are conveyed to the No. 1 thickener (steelmaking). The

reduction mill uses lubricant and roll coolant containing 5% animal fat, which is disposed of to the coal pile after use. Soap solutions from the Temper mill operations discharges to the collection sumps in the basement together with floor drains. This wastewater is conveyed to an external oil/water separator. Underflow is conveyed to the main filter plant.

Finishing operations at Dofasco include Acid Pickling, Cold Rolling, Alkaline Cleaning, Annealing, Galvanizing, Electrolytic Tinning, Tempering, and Coating. There are three finishing plants at the Dofasco facility. These include the Main Plant, the Kenilworth Plant and the Bayfront Finishing Operations. The Main Plant finishing facilities are as follows:

- No. 1, 2 and 3 Pickle Lines
- No. 1 and 2 Cleaning Lines
- No. 1 and 2 Tandem Cold Mills
- 4-56 Inch Cold Mill
- 1-66 Inch Cold Mill
- 42 Inch Temper Mill
- 56 Inch Temper Mill
- 1-66 Inch Temper Mill
- 2-66 Inch Temper Mill
- Batch Annealing Lines
- Open Coil Annealing Lines
- No. 2 Tower Anneal Line
- No. 1 and 2 Galvanizing Lines
- No. 2 and 3 Electrolytic Plating Lines

The wastewater from the Main Plant finishing operations, including oily wastewater, alkaline and acid rinses, is treated at the Cold Mill Wastewater Treatment Plant. Treatment facilities consist of pH adjustments followed by settling in clarifiers prior to discharge to the Regional Pollution Control Plant. Oily wastewaters are also treated by emulsion breaking and oil/water separation. Effluent quality varies considerably essentially due to insufficient storage capacity to smooth variations in flow and loading from several different sources. Spent pickle acids are recovered in the No. 1 Acid Recovery Plant. Wastewater from the No. 1 ARP tail gas scrubbers is currently

discharged to the Hamilton-Wentworth sanitary sewer system after neutralization. Electrolytic Chrome wastewaters from No. 2 and No. 3 electrolytic plating lines are treated separately by ion exchange prior to discharge off site. The Kenilworth Plant finishing operations include the No. 4 Pickle Line and the new Continuous Pickle Cold Mill Line, which is under construction. The acid rinse from the No. 4 Pickle line currently discharges to the sanitary sewer system. Spent acid from the No. 4 Pickle line is currently regenerated at the No. 2 ARP. Wastewater from the No. 2 ARP tail gas scrubbers is currently discharged to the Hamilton-Wentworth sanitary sewer system after neutralization. Dofasco plans to discharge acid rinses from the No. 4 Pickle line, tail gas scrubber effluent from the No. 2 ARP and acid rinses from the new Continuous Pickle Continuous Cold Mill line, to the Kenilworth Cold Mill Wastewater Treatment Plant, once construction of this facility is completed[2]. Finishing facilities are also located at the Bayfront Finishing Operations. This plant has the following finishing facilities:

- No. 3 Galvanizing Line
- No. 4 Galvanizing Line
- No. 5-56 Inch Cold Mill
- Magnesium Oxide Coating Line

The rinsewater and sump water from the No. 3 and No. 4 Galvanizing Lines is discharged directly to the sanitary sewer system. Spent high density cleaning solution from the No. 4 Galvanizing Line and the wastewater from the recoiler and payoff pits at the No. 3 and No. 4 Galvanizing Lines is collected and transported to the Main Plant Cold Mill Wastewater Treatment Plant. Waste rolling solution and washdown water from the No. 5-56 Inch cold Mill is also treated at the Main Plant Cold Mill Wastewater Treatment Plant. The wastewater from the Magnesium Oxide Coating Line is directed to the Magnesium Oxide Clarifier then discharged to the sanitary sewer system.

Stelco Hilton also has extensive and complex finishing operations, including cold rolling, cold rolled sheet finishing, tin coating, galvanizing and acid pickling. In general, oily wastes are treated at Waste Oil Recovery Plant, (which includes pH adjustment, addition of flocculant

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[2]As of January 1, 1992 these plans have been implemented.

chemicals and dissolved air flotation process). After treatment effluent flows to the East Side Filtration Plant (ESFP). Acid Pickling spent acids are recovered in the HCl Acid Regeneration Plant. Rinse waters are cascaded on lines 1 and 2, and cascaded and recycled on line 3, and discharged to the ESFP. Rinse water from Electrolytic Tinning lines are discharged to the ESFP. Spent acid and alkali solutions are stored on site for disposal off site. Chrome solution is treated at the ion exchange plant. Rinse water from No. 1 Galvanizing line and the new Z line discharge to the ESFP. Spent acid, alkali and chrome solutions are collected, treated, and disposed of off-site.

Stelco LEW does not have finishing operations at their facility.

An assessment of the overall effectiveness of Dofasco's and Stelco Hilton is not possible due to the lack of comprehensive category discharge data and the geographically dispersed nature of the operations.

It is difficult, due to lack of specific effluent data, to assess Stelco Hilton finishing effluents as they are combined with many other process and non contact cooling waters prior to filtration at the ESFP. Data is available for Dofasco's existing cold mill plant, but not for the No. 1 and No. 2 ARP, or the existing Kenilworth or Bayfront Operation.

An assessment of the unit treatment processes utilized at each plant would indicate that treatment is generally similar for concentrated waste streams, spent pickle acids etcetera. Stelco Hilton Waste oil recovery plant may be more effective in oil removal than Dofasco's cold mill WWTP but no data is available. Dofasco's CM WWTP exhibits good metals removal from acidic wastewater but poor suspended solids and oil removal due to equipment problems.

Dofasco's Cold Mill WWTP is selected as BAT #1 because: (1) data is available for its performance, and (2) it demonstrates good metals removal.

A summary table, Table 5.1.3, *Effluent Data for Model BAT #1 Best in Ontario*, shows the emissions for each category.

TABLE 5.1.3: EFFLUENT DATA FOR MODEL BAT #1 – BEST IN ONTARIO

SECTOR:	INTEGRATED MILLS									NON-INTEGRATED	
CATEGORY:	Coke-making	Sintering	Iron-making	BOF Steel. Supp - Wet (1)	Cont. Casting	Hot Forming	Finishing	Int. Mill - Excl. Fin.	Int. Mill - Incl. Fin.	Specialty Mills	Mini Mills
BAT #1 Mill:	Stelco LEW		Stelco LEW	Stelco LEW	Stelco LEW	Stelco LEW	Dofasco	Stelco LEW			Ivaco
Flow (m3/tonne):	0.60		0.80	1.1	1.4	0.85	1.1	4.7			1.0
POLLUTANT	(g/tonne)	No BAT #1.	(g/tonne)	(g/tonne)	(g/tonne)	(g/tonne)	(g/tonne)	(g/tonne)	See data	No BAT #1.	(g/tonne)
TSS	4.4	Stelco	3.9	5.5	6.6	4.2	530	23	Stelco LEW	Atlas is	10
oil and grease	0.86	Hilton is	–	–	2.0	5.3	75	6.5	(Int. Mill -	only spec.	5
ammonia + ammonium	0.10	only mill	0.41	–	–	–	–	0.39	Excl. Fin.)	steel mill	–
cyanide total	0.56	with	0.37	–	–	–	–	0.53	+	in Ontario.	–
phenolics	0.0073	sintering	0.0098	–	–	–	–	0.011	Dofasco		–
lead	–	in Ontario.	0.018	0.11	–	–	0.095	0.15	(Fin.)		–
zinc	–		0.035	0.21	–	–	0.17	0.30			–
benzene	0.0031		–	–	–	–	–	0.0012			–
benzo(a)pyrene	0.0062		–	–	–	–	–	0.0024			–
naphthalene	0.0037		–	–	–	–	–	0.0014			–
chromium	–		–	–	–	–	0.88	0.044			–
hexavalent chromium	–		–	–	–	–	–	–			–
cadmium	–		–	–	–	–	–	–			–
nickel	–		–	–	–	–	–	–			–

(1) BOF Steelmaking BAT #1A is Stelco LEW, Suppressed Combustion, Wet Gas Cleaning.
BOF Steelmaking BAT #1B is Stelco Hilton, Open Combustion, Dry Gas Cleaning.

Files: SUMMODB1.WK1 and SUMMODB1.ALL

5.1.3 BAT #2 Best in the USA

In a similar manner to BAT #1 Best in Ontario, US mills are compared on the basis grams/tonne emissions. The discharge data is provided by the reporting requirements that each mill is required to adhere to under the *NPDES system. Production data is also provided under the NPDES system but is generally a rated production figure. In the case of National Midwest, specific production figures were obtained by G.A. Amendola. The M.O.E. provided actual production data for the following mills: Bethlehem, Sparrows Point, Sintering; Bethlehem, Sparrows Point, Ironmaking; Inland, Indiana Harbour, #4 BOF Steelmaking; USS Gary Works, 84" Hot Strip Mill, Hot Forming. Rated production figures were used for the remaining mills on the basis of verbal confirmation given to G.A. Amendola by the mills.

Whilst every effort has been made to acquire accurate production figures, no "audit" has been completed. Mills are, of course, under no obligation to release actual production figures and in some instances have chosen not to.

Wastewater treatment systems at several integrated mills known to have exemplary treatment were surveyed to determine their performance characteristics. Since there are limited opportunities for recycle and reuse of Cokemaking and Finishing wastewaters, the principal focus was on those mills with well-operated coke plant biological treatment systems and Finishing mill treatment systems; and, those mills with high rate recycle systems and minimal blowdown rates for Sintering, Ironmaking, Steelmaking, Vacuum Degassing, Continuous Casting and Hot Forming operations. The mills identified generally perform better than U.S. BAT effluent limits.

Cokemaking

Inland Steel's treatment system for the No. 11 Coke Battery and USS Clairton Works coke plant treatment system at the USS Clairton Works were selected as representing some of the best coke plant biological treatment systems in the United States. The Inland No. 11 Coke Battery has limited by-product recovery. Recovered ammonia is incinerated and crude light oil is not removed from the coke oven gas. Accordingly, only waste ammonia liquor and coal preheater scrubber water are treated. Anhydrous ammonia, crude light oil and crude coal tars are recovered at the USS Clairton Works. Wastewater from an adjacent tar separation plant are also treated.

* *NPDES - National Pollutant Discharge Elimination System*

The treatment systems at both plants include free and fixed ammonia stripping. The stills at Inland are operated with caustic, while those at USS are operated with lime. Other significant differences include the addition of dilution water at USS and introduction of enhanced biocultures cultivated on-site at Inland. Neither treatment system includes post filtration or alkaline chlorination as practised at Stelco LEW.

Clairton and Inland are very similar in effluent quality. Inland was selected because of lower ammonia level (important for toxicity), apparently reflecting better nitrification control in the wastewater treatment plant.

Sintering

As outlined above in BAT #1 evaluation, Ontario only has one sinter plant at Stelco Hilton and it is integrated with ironmaking. Therefore, sintering is not pursued as a separate category. It is reviewed here to provide a basis for comparison for BAT #2.

Sinter plants at the Bethlehem Steel-Sparrows Point Plant and the USS Gary Works were evaluated. Gas cleaning waters at both plants are recycled. The Sinter Plant scrubber water at the USS Gary Works is co-treated with blast furnace gas wash water in a large centralized recycle system. Most of the system blowdown is disposed of by evaporation on blast furnace slag. No treatment is provided for the remaining blowdown. Sinter Plant gas scrubber water at Bethlehem Steel is independently recycled. The blowdown is co-treated with blast furnace recycle system blowdown in a metals and cyanide high density sludge precipitation system. None of the blast furnace or sinter plant blowdown is disposed of by slag quenching. Alkaline chlorination of the Sinter Plant blowdown is not practised at either plant.

Based on overall performance, US Steel Gary Works was selected as having BAT #2. However, where disposal of blowdown on slag is not possible, the blowdown would be treated in the Bethlehem Steel Sparrow Point Plant blowdown treatment system.

Ironmaking

High rate recycle of blast furnace gas wash waters is almost universally practised at U.S. integrated mills. Blowdown treatments are generally not provided since the applicable effluent limitations at many mills can be achieved with high rate recycle and disposal of at least a portion of the resulting blowdowns through slag quenching. In several cases, mill operators have obtained variances from applicable ammonia-N BAT effluent limitations, thus eliminating the need for alkaline chlorination which was part of the Model U.S. BAT treatment system.

Disposal of blowdown is not practised at the two Wheeling-Pittsburgh Steel Blast Furnace Plants and the Bethlehem Steel-Sparrows Point Plant. For plants that do not dispose of blowdown by slag quenching, the lowest overall discharges are achieved by Bethlehem Steel-Sparrows Point.

Inland Steel Indiana Harbour, with zero discharge of blowdown from blast furnace gas cleaning, was selected for BAT #2, except where disposal of blowdown on slag is not possible. For the latter, Bethlehem Sparrows Point would be BAT #2.

Steelmaking

The standard treatment for Basic Oxygen Furnace (BOF) suppressed combustion and open combustion gas cleaning and cooling waters is high rate recycle followed by treatment of the resulting blowdown for removal of toxic metals. Information and data were obtained for five U.S. steelmaking operations with wet gas cleaning systems. Two have suppressed combustion off gas systems (LTV Steel-Cleveland, USS/KOBE Steel-Lorain); two have open combustion systems (Inland Steel-No. 4 BOF; Wheeling-Pittsburgh Steel-Mingo Junction); and one has a three furnace shop with two open combustion vessels and one suppressed combustion vessel (Bethlehem Steel-Burns Harbor).

LTV Steel operates the gas cleaning water system as a water softener using CO_2 injection. A minimal intermittent blowdown is discharged to an adjacent continuous caster recycle system.

LTV and Inland Steel have the lowest discharge flow and pollutant loadings for suppressed and open combustion systems employing wet gas cleaning systems, respectively, of the U.S. mills surveyed. LTV was therefore selected as BAT #2A for Steelmaking - Suppressed Combustion

and Inland Steel was selected as an alternate BAT #2B for Steelmaking - Open Combustion with wet gas cleaning systems.

Some open combustion mills utilise dry or "semi-wet" (US EPA designation) gas cleaning systems. Examples would be Bethlehem Steel, Bethlehem Works, Gulf States Steel and Warren Consolidated. These systems are selected as BAT #2C.

Vacuum Degassing

Standard treatment for intercondenser cooling water for Vacuum Degassing operations is high rate recycle, generally including cooling the entire recirculating flow and treatment of a relatively small side stream for control of suspended solids. Several operators have reported problems with inadequate solids removal affecting cooling tower heat transfer. Effluent quality data specific to Vacuum Degassing operations were not available. Blowdown flow rates for two Vacuum Degassing plants are presented below:

Inland Steel	0.038 m^3/tonne
USS Gary Works	
Design	0.051 m^3/tonne
Actual	0.17 m^3/tonne

The USS Gary Works vacuum degasser recycle system is operated with a constant blowdown. Production rates lower than design production resulted in a higher blowdown rate than anticipated in the system design.

Unfortunately, long-term effluent quality data specific to these systems are not currently available. Therefore, this category was not evaluated in this study.

Continuous Casting

Virtually all continuous casters at U.S. integrated mills are operated with closed cooling systems for mold and machine cooling applications and high rate recycle for spray water systems. The spray water systems generally consist of scale pits, gravity or pressure filtration systems and cooling towers. In many cases, the recycle system blowdowns are co-treated with blowdowns

from BOF and Vacuum Degasser recycle systems. Flow data were obtained for five continuous casters and effluent quality data were obtained for three. Four of the five casters are slab casters, and one (USS/KOBE Steel) is a billet/rounds caster.

Inland Steel Indiana Harbour was selected to represent BAT #2 for Continuous Casting. The treatment system consists of a scalping pit, a scale pit with oil skimming, pressure sand filters and a cooling tower. A small blowdown flow is discharged from this system.

Hot Forming

For purposes of this project, all hot forming operations (primary, section, flat and pipe and tube) were grouped into one category. The wastewater characteristics from all hot forming operations are similar, the principal difference being the applied and discharge flow rates. Total suspended solids, and oil and grease are the principal contaminants. Trace levels of lead and zinc may also be found. Since applied process water rates per ton of steel processed for hot strip mills are among the highest for hot forming mills, data for two hot strip mills with high rate recycle systems were obtained to represent the best treatment in the U.S. for hot mills. US Steel Gary Works was selected for BAT #2 for Hot Forming. (Although LTV Cleveland appears to have lower discharge, the only data available was typical effluent quality provided by LTV Steel.)

Finishing Operations

As noted above, all steel Finishing operations with wastewater discharges were combined into one category for this project. The Finishing operations include acid pickling, cold rolling, alkaline cleaning, hot coating, electro-plating, and salt bath descaling. Although the process wastewater characteristics are not similar, the wastewaters can effectively be co-treated provided proper equalization and pretreatments are provided. Standard practice at U.S. integrated mills with Finishing operations is to provide separate treatment for emulsified oils, pretreatment and equalization of high concentration metal bearing streams, equalization of high strength cleaning solutions followed by pH control and sedimentation for metals removal. Three Finishing mill treatment systems were surveyed as part of this study (National Steel - Midwest Division; USS Gary Works; and, LTV - Indiana Harbor Works).

Pickling production was selected as the base production rate to normalize effluent loadings. Although the production mix at each Finishing plant is different, all steel processed must be pickled. A review of the ratios of cold rolling, alkaline cleaning, hot coating and electro-plating production to pickled production for the Ontario and U.S. mills included in this study indicates reasonably good agreement for the hot coating and electroplating operations where the highest generation of toxic metals occurs. National Steel, Midwest Division, with the lowest effluent loadings was selected to represent BAT #2 for Finishing.

A summary table, Table 5.1.4, *Effluent Data for Model BAT #2 Best in The United States*, gives the BAT #2 emissions for each category.

TABLE 5.1.4: EFFLUENT DATA FOR MODEL BAT #2 – BEST IN THE UNITED STATES

SECTOR:	INTEGRATED MILLS											NON – INTEGRATED		
CATEGORY:	Coke–making	2A Sint. (1)	2B Sint. (1)	2A Iron. (2)	2A BOF St. Supp – Wet (3)	2B BOF St. Open – Wet (3)	Cont. Cast.	Hot Form.	Finish.	Int. Mill – Excl. Fin.	Int. Mill – Incl. Fin.	Specialty Mills Finish.	Specialty Mills HF & CC	Mini Mills
BAT #2 Mill:	Inland,IH	USS,Gary	Beth.,SP	Beth.,SP	LTV,Cl.	Inland,IH	Inland,IH	USS,Gary	Nat.,Mid.	Nat.,Gr.	Nat.,Gr.	Mercury	(4)	Nucor
Flow (m3/tonne):	0.54	0.0091	0.46	0.26	0.0020	0.24	0.076	0.36	6.1	7	10	4.6	0.37	–
POLLUTANT	(g/tonne)	(g/tonne)	(g/tonne)	(g/tonne)	(g/tonne)	(g/tonne)	(g/tonne)	(g/tonne)	(g/tonne)	(g/tonne)	(g/tonne)	(g/tonne)	(g/tonne)	(g/tonne)
TSS	31	0.12	4.0	2.2	0.0083	0.72	1.4	1.1	29	40	54	85	2.3	
oil and grease	0.69	0.12	2.7	–	–	–	0.16	2.3	14	42	49	4.6	2.0	
ammonia + ammonium	0.93	0.77	28	16	–	–	–	–	–	5.9	5.9	–	–	(No
cyanide total	3.6	0.0019	0.064	0.036	–	–	–	–	–	–	0.034	–	–	Effluent –
phenolics	0.022	0.00011	0.038	0.022	–	–	–	–	–	0.029	0.029	–	–	used for
lead	–	0.00050	0.0087	0.0049	0.000057	0.014	0.0087	–	–	0.047	0.047	0.46	0.0087	slag
zinc	–	0.011	0.091	0.052	0.00036	0.027	0.0080	–	0.33	0.29	0.45	–	0.0080	evaporation
benzene	0.0015	–	–	–	–	–	–	–	–	–	–	–	–	& electrode
benzo(a)pyrene	0.011	–	–	–	–	–	–	–	–	–	–	–	–	cooling)
naphthalene	0.0058	–	–	–	–	–	–	–	–	–	–	–	–	
chromium	–	–	–	–	–	–	–	–	0.31	–	–	0.54	–	
hex. chromium	–	–	–	–	–	–	–	–	0.066	–	–	0.10	–	
cadmium	–	–	–	–	–	–	–	–		–	–	0.052	–	
nickel	–	–	–	–	–	–	–	–		–	–	1.0	–	

(1) Sintering BAT #2C – Inland Steel, IH. Dry gas cleaning.
(2) Ironmaking BAT #2B – Inland Steel, IH. Effluent evaporated on slag.
(3) Steelmaking BAT #2C, Open Combustion, Dry (Semi–Wet) Gas Cleaning.
Examples: Bethlehem Steel, Bethlehem, Gulf States Steel, Warren Consolidated.
(4) See USS,Gary (Hot Forming) + Inland,IH (Continuous Casting)

Files: SUMMODB2.WK1 and SUMMODB2.ALL

5.1.4 BAT #3: Best at Selected World Locations

An evaluation of the information obtained during the visits to selected plants in Germany, Holland, Japan and Korea indicated that their wastewater treatment technologies could not be considered superior to those in use in Ontario and the USA.

The technology of most interest at Thyssen in Germany is the use of a Lurgi-Thyssen dry electrostatic precipitator to clean uncombusted Steelmaking (BOF) off-gas. This unit has a circular cross-section which minimizes the potential for explosions. There is no effluent. Efficient dust removal is reported. Most of the wastewater blowdown from Thyssen is treated in combined municipal and industrial treatment plants. This practice does not allow the segregation of waste streams, which tends to dilute toxic streams rather than treat them.

Hoogovens in Holland is well advanced in the use of Pulverized Coal Injection (PCI) in the blast furnace. Coke consumption is consequently about 40% less. Typically 1 tonne of molten iron requires 400-500 kg of coke to manufacture. Therefore coke consumption can be reduced by up to 200 kg per tonne of iron produced. This technology is also practised at USINOR mill at Dunkirk, France. This is an important emerging technology but not, in itself, eligible for BAT because it would have to be combined with advanced treatment of coke oven effluent.

Hoogoven's advised that the only wastewater treatment system at their plant which was world class and operating successfully was the coke oven excess flushing liquor precoat vacuum filtration system. The fluidized bed coke plant biological treatment plant, while promising, is still being commissioned. The other wastewater treatment systems are standard steel industry practice.

The approach to effluent control at the Kwangyang Works is to reduce water use at source and then treat discharge streams in two parallel treatment facilities. Recirculation is minimal because the fresh water is quite hard. The most notable feature of the effluent treatment system is final treatment by activated carbon to reduce organics in the final effluent.

Extensive use of recycling and cascading is practised at NKK Keihin Works, and water is used very efficiently at their modernized facilities. Activated carbon is used to reduce COD in the final

effluent. Otherwise, the treatment systems consist of biological treatment of coke oven effluent and extensive use of sedimentation basins.

Very little sampling and monitoring data is available from the overseas mills because the legal requirements to do so do not seem to be in force.

For this reason, and because we did not observe technology better than that in North America, the BAT #3 selections are from Canada and the USA as follows:

Cokemaking	BAT #1
Sintering	BAT #2
Ironmaking	BAT #1
Steelmaking	BAT #2 (suppressed combustion) or BAT #1 (open combustion)
Continuous Casting	BAT #2
Hot Forming	BAT #2
Finishing	BAT #2
Integrated Mills	BAT #1

For steelmaking BAT #3 suppressed combustion, the Lurgi-Thyssen dry gas cleaning process as practised at Thyssen in Germany, and Posco South Korea was considered. After review with representatives of the Joint Technical Committee, this process was not selected as Best at Selected World Locations. Posco in its subsequent steelmaking shops #3 and #4 has reverted to wet gas cleaning. Difficulties are perceived with transferring this technology successfully to Ontario mills. Therefore LTV Cleveland was selected as BAT #3 for this category.

Table 5.1.5, *Effluent Data for Model BAT #3 Best in the World*, summarizes the data for each category.

TABLE 5.1.5: EFFLUENT DATA FOR MODEL BAT #3 – BEST IN THE WORLD

SECTOR:	INTEGRATED MILLS										NON - INTEGRATED		
CATEGORY:	Coke-making	3A Sint. (1)	3B Sint. (1)	Iron-making	3A BOF Stlmkg Supp. - Wet (2)	Cont. Casting	Hot Forming	Finishing	Int. Mill – Excl. Fin.	Int. Mill – Incl. Fin.	Specialty Mills Finishing	Specialty Mills HF & CC	Mini Mills
BAT #3 Mill:	Stelco LEW	USS,Gary	Beth., S.P.	Stelco LEW	LTV Cl.	Inland, IH	USS, Gary	Nat., Mid.	Stelco LEW		Mercury	BAT #2	
Flow (m3/tonne):	0.60	0.0091	0.46	0.80	0.0020	0.076	0.36	6.1	4.7		4.6	0.37	
POLLUTANT	(g/tonne)	(g/tonne)	(g/tonne)	(g/tonne)	(g/tonne)	(g/tonne)	(g/tonne)	(g/tonne)	(g/tonne)	see data	(g/tonne)	(g/tonne)	
TSS	4.4	0.12	4.0	3.9	0.0083	1.4	1.1	29	23	Stelco LEW	85	2.3	Nucor
oil and grease	0.86	0.12	2.7	-	-	0.16	2.3	14	6.5	(Int. Mill –	4.6	2.0	
ammonia/ammonium	0.10	0.77	28	0.41	-	-	-	-	0.39	Excl. Fin.)	-	-	(no
cyanide total	0.56	0.0019	0.064	0.37	-	-	-	-	0.53	+	-	-	effluent –
phenolics	0.0073	0.00011	0.038	0.0098	-	-	-	-	0.011	Nat. Mid.	-	-	used for
lead	-	0.0005	0.0087	0.018	0.000057	0.0087	-	-	0.15	(Fin.)	0.46	0.0087	slag
zinc	-	0.011	0.091	0.035	0.00036	0.0080	-	0.33	0.30		-	0.0080	evaporation
benzene	0.0031	-	-	-	-	-	-	-	0.0012		-	-	& electrode
benzo(a)pyrene	0.0062	-	-	-	-	-	-	-	0.0024		-	-	cooling)
naphthalene	0.0037	-	-	-	-	-	-	-	0.0014		-	-	
chromium	-	-	-	-	-	-	-	0.31	0.044		0.54	-	
chromium (VI+)	-	-	-	-	-	-	-	0.066	-		0.10	-	
cadmium	-	-	-	-	-	-	-	-	-		0.052	-	
nickel	-	-	-	-	-	-	-	-	-		1.0	-	

(1) Sintering BAT #3C – Inland Steel, IH. Dry gas cleaning.
(2) Steelmaking BAT #3B – Stelco Hilton, Open Combustion, Dry Gas Cleaning.

Files: SUMMODB3.WK1 and SUMMODB3.ALL

5.1.5 BAT #4: Non-Lethal

As stated in Section 5.1.1, in order to determine BAT #4, the long term monitoring data for the mill identified as BAT #3 - Best in the World was evaluated to assess whether the effluent would be lethal or non-lethal. The BAT #4 assessments for each category are given in Sections 5.2 to 5.10.

5.1.6 BAT #5: Virtual Elimination of Persistent Toxics

The meaning of virtual elimination has not been defined by the MOE. BAT #3 technology already produces effluent emissions that are very low in concentration of all pollutants, and extremely low for the toxic contaminants. Further significant reductions are unlikely to be obtained by application of current technology. In the absence of a definition of "Virtual Elimination" it appears in practical terms that further reduction of contaminants emitted will be pursued indefinitely as detection methods and technologies improve.

As a practical approach for this study, virtual elimination is defined as zero wastewater discharge with zero or minimal transfer of pollutants to other media whenever persistent toxics are contained in the wastewater. The reason for this decision was that detection limits are becoming so low that, to guarantee virtual elimination, zero discharge of effluent containing toxics is required.

In the longer term non-recovery cokemaking is likely to be a better technical alternative to treatment and recycle of cokemaking effluent.

5.1.7 Non-Integrated Mills

There are three non-integrated mills in Ontario:

Ivaco
Lasco
Atlas

Ivaco and Lasco are carbon steel producers with Electric Furnace Steelmaking, Continuous Casting and Hot Forming operations. Atlas is a specialty steel producer with Electric Furnace

ladle metallurgy, Continuous Casting, Hot Forming, Forging, and limited pickling and descaling operations.

Lasco and Atlas have partial recycle systems installed, and Atlas has a separate treatment system for waste pickling acids, descaling rinse waters and spent acids generated off site. Ivaco has a high rate recycle system and operated with no discharge during the MISA monitoring period. Ivaco reports however, it must operate with at least an intermittent blowdown.

For purposes of this study, Ivaco and Lasco were considered in one category. Atlas must be considered separately due to the nature of its operations.

5.1.7.1 Mini Mills

BAT #1: Best in Ontario

The best available treatment in Ontario was demonstrated by Ivaco during the MISA monitoring period when it operated with no reported discharge. Accordingly, there are no MISA monitoring data available. Ivaco advise that this mode of operation is experimental and cannot be sustained indefinitely without serious product quality problems caused by the recirculating water systems. Ivaco wishes to make provision for a blowdown, estimated at 0.26 m^3/tonne but not greater than 1 m^3/tonne. Effluent characteristics are expected to be < 10 ppm TSS and <5 ppm oil and grease. After extensive review and discussion by the BAT subcommittee of the Joint Technical Committee, Ivaco with this blowdown flow was selected as BAT #1.

BAT #2: Best in the USA

The NUCOR Steel mill at Crawfordsville, Indiana, is a non-integrated carbon steel producer with process operations similar to those at Ivaco and Lasco. The mill operates with no process wastewater discharge to receiving water and therefore meets the criteria for BAT #3, BAT #4, and BAT #5. Continuous Casting and Hot Forming wastewaters are recycled at a high rate. A side stream is treated with a cold-lime softening system. Chloride concentrations are controlled by evaporation of a small blowdown on electric furnace slag and from direct cooling of electrodes. The Indiana Department of Environmental Management does not permit the mill to discharge process wastewater to receiving water.

Ivaco and Lasco have expressed concern and reservations that this technology may not be directly transferable to their mills, although Ivaco accepts that <2% blowdown is achievable. Further flow reduction beyond this will require testing and technology demonstration at the mills. Evaporation of caster and hot forming wastewater on slag or electrodes is believed acceptable to MOE, as these wastewaters do not contain cyanide or ammonia.

5.1.7.2 Specialty Mills

BAT #1: Best in Ontario

Since Atlas is the only specialty steel producer, no selection for Best in Ontario BAT #1 is possible, in accordance with the MISA Issues Resolution Recommendation.

BAT #2: Best in the USA

The Finishing operations at Atlas Steel produce wastewaters that are not compatible with wastewaters from Vacuum Degassing, Continuous Casting, Hot Forming, Forging and non-contact cooling operations, and therefore are treated separately. Data from a U.S. mill with specialty steel Finishing operations was evaluated for application to Atlas. Best available treatment for wastewaters from the remaining operations (Continuous Casting and Hot Forming) can be recycled to a high degree as was recommended for the integrated mills.

The BAT #2 was judged to be Mercury Stainless-Massillon, Ohio. The plant treats waste hydrofluoric/nitric acids, rinse waters from specialty steel pickling operations and a relatively small volume of cold rolling wastewaters in a metals precipitation system.

BAT #3: Best at Selected World Locations

No Specialty Mill outside of Canada or the USA was identified for evaluation during this study. Therefore, BAT #3 is the same as BAT #2, since there is no BAT #1.

BAT #4: Non-Lethal

As stated in the mill identified as Section 5.1.1, in order to determine BAT #4, the long term monitoring data for BAT #3 - Best in the World was evaluated to assess whether the effluent would be lethal or non-lethal (see Section 5.14.4).

BAT #5: Virtual Elimination

The Hot Forming wastewater streams are not expected to contain persistent toxics so virtual elimination is not applicable. Finishing wastewaters are likely to contain nickel which is a persistent bioaccumulative toxic. Virtual elimination can only be assured by technologies such as evaporation, or ultrafiltration and ion exchange applied to the Finishing wastewater prior to recycle of the treated water back into the process. This will provide no discharge to receiving waters. However, these technologies are not proven in this context in this industry sector.

5.1.8 Model BAT Costing

The objective for developing the Model BAT costs was to provide assistance in determining the practicality of the Model BAT's at an early stage (that is before extensive work was done in applying and costing the technology). It was considered that in some cases the costs might be so high that the lack of economic achievability would be very obvious.

Thus order-of-magnitude capital and operating costs were determined by the methodology described in Section 1.4. The basis of the costs, in terms of battery limits and approximate plant capacity can be understood by reference to the Model BAT flowsheets.

These costs cannot be compared to the Applied BAT costs in Volume II because the basis, capacity, battery limits and other parameters could be very different. Design parameters and breakdowns of the cost are not included herein because to do so would imply a level of detail that would be inappropriate. On-site storage of solid wastes is assumed.

It is important to note that no potential BAT technology was excluded from consideration simply because of order-of-magnitude estimates which appeared to be excessive.

5.2 Integrated Mills - Cokemaking

5.2.1 BAT #1 Best in Ontario

The best Cokemaking wastewater treatment system in Ontario was determined to be Stelco's Lake Erie Works facility in Nanticoke, Ontario. This is shown schematically in Figure 5.2.1 *Cokemaking Model BAT #1 Best in Ontario*. The various wastewater streams are collected in an equalization tank then pumped to the ammonia still for removal of free and fixed ammonia. Caustic is added to the ammonia still to improve the removal of fixed ammonia. The ammonia concentration is reduced to between 100-150 ppm after the still.

The wastewater from the ammonia still flows to the biological treatment plant aeration basins. The retention time in each basin is about 18 hours. Approximately 20% of the untreated water is directed to the second basin to maintain an adequate carbonaceous food supply in the basin to feed the bacteria. The average sludge age in the basins is 80 days. The water from the second basin is clarified in the secondary clarifier, then pumped to the Blowdown Treatment Plant for chlorination and additional solids removal before discharge to Pond #4 and then to the receiving water. Most of the sludge is returned to the aeration basins. The excess sludge is dewatered further in a thickener and sprayed onto the coal at the coal conveyor for return to the ovens.

The pushing emissions control wastewater and the non-contact cooling water blowdown are used for coke quenching at the quench tower breeze basin.

The following data shows typical influent and effluent concentration data for parameters monitored at the biological treatment plant:

Parameter	In (mg/l)	Out (mg/l)
Ammonia	100-150	0-10
Thiocyanate	500	0-1
Phenol	500	0-1
Free Cyanide	10	1-3
COD	2400	200
TSS		25-55

The effluent data sheet, Table 5.2.1, for this treatment technology is attached.

The order-of-magnitude capital and operating costs for the Model BAT #1 Cokemaking are $\$20 \times 10^6$ and $\$2 \times 10^6$ respectively.

The use of caustic instead of lime for the removal of fixed ammonia in the ammonia still reduces the amount of solids to landfill since there is no solids associated with the use of caustic. In addition, the practice of spraying the biological sludge onto the coal to the coke ovens reduces the requirement for solids disposal and adds to carbon back into the system. The addition of process units to the treatment system, however, will increase the energy requirement of the process. The use of the PEC blowdown for coke quenching may cause the fine particulates in the water to be re-suspended which would adversely affect air quality.

5.2.2 BAT #2 Best in the United States

The best Cokemaking wastewater treatment technology available in the United States is at Inland Steel Corp., Indiana Harbor Works, East Chicago, Indiana. This treatment system is shown schematically in Figure 5.2.2 *Cokemaking Model BAT #2 Best in the United States*. The ammonia is stripped from the wastewater in an ammonia still with caustic addition. The wastewater is pumped to equalization tanks then combined with the coal preheat emission control scrubber water for biological treatment. The coal preheat emission control scrubber water is clarified before combining it with the water from the ammonia still. The clarifier underflow is returned to the coke ovens.

The biological treatment plant consists of two aeration basins operated in series. The retention time in the basins is about four days. The water from the second aeration basin flows through two secondary clarifiers in series then discharges to the receiving water. The sludge collected in the first clarifier is returned to the basins, while the sludge collected in the second clarifier is disposed of in the coke ovens. Sludge from the first clarifier is periodically sent to the coke ovens to reduce the level in the clarifier.

Inland Steel cultivates populations of nitrifying bacteria in separate small reactors and continuously feeds supplemental bacteria to the return activated sludge. Inland has also experimented with cultivating and using bacteria strains to enhance phenol and complex cyanide removal.

The effluent data sheet, Table 5.2.2, for this treatment technology is attached.

The order-of-magnitude capital and operating costs for Model BAT #2 Cokemaking are $\$18 \times 10^6$ and $\$2 \times 10^6$ respectively.

The non water quality impacts of this system are the same as the BAT #1 impacts described in section 5.2.1.

5.2.3 BAT #3 Best at Selected World Locations

The best available technology was determined to be Stelco's Lake Erie Works facility. This technology is detailed in section 5.2.1.

Other emerging options could be considered for the longer term. For example, Sun Coal in Virginia has developed a non-recovery (of chemicals) Cokemaking process which has been tested at their facility. The coke oven gas is used as a source of fuel for co-generation and is cleaned by a dry system. Inland Steel has announced its intention to construct a large scale demonstration facility.

Pulverized coal injection through blast furnace tuyeres is now being used to reduce coke usage. Hoogovens in Holland has demonstrated the feasibility of reducing coke by about 40 per cent.

Pulverized coal injection is also practised at Posco's Kwangyang Works in South Korea and NKK's Keihin works in Japan.

Air quality may be affected by the use of non-recovery cokemaking if the cyanide destruction and sulphur removal technologies are not as efficient as the biological treatment system.

The use of direct coal injection may affect the quality of the furnace off gas.

5.2.4 BAT #4 Non-Lethal

The Best Available Technology #3 for Cokemaking wastewater treatment was determined to be the BAT #1 treatment process. This technology is detailed in section 5.2.1.

There is no specific toxicity data available for the disaggregated Cokemaking wastewater stream. However, based on an assessment of the expected effluent characteristics, specifically the single contaminant LC50 values, the effluent toxicity, as determined by the Ontario Toxicity Test, is probably marginal. The synergistic effects of the several contaminants in the effluent are not known and cannot be predicted. No demonstrated technologies are known to further reduce the concentrations of organic toxics to lower levels than those measured in this wastewater. This stream is not discharged directly to the receiving water, but is combined with other streams and co-treated in a Blowdown Treatment Plant for metals removal and further cyanide and ammonia reduction prior to discharge. The discharge is to Pond 4 which also receives surface water run-off and NCCW. A review of MIDES 0400 and 0100 data indicates free and total chlorine levels are reduced across Pond 4 which may assist in the effluent passing the Ontario Toxicity Test. The combined process stream generally passes the Ontario Toxicity Test.

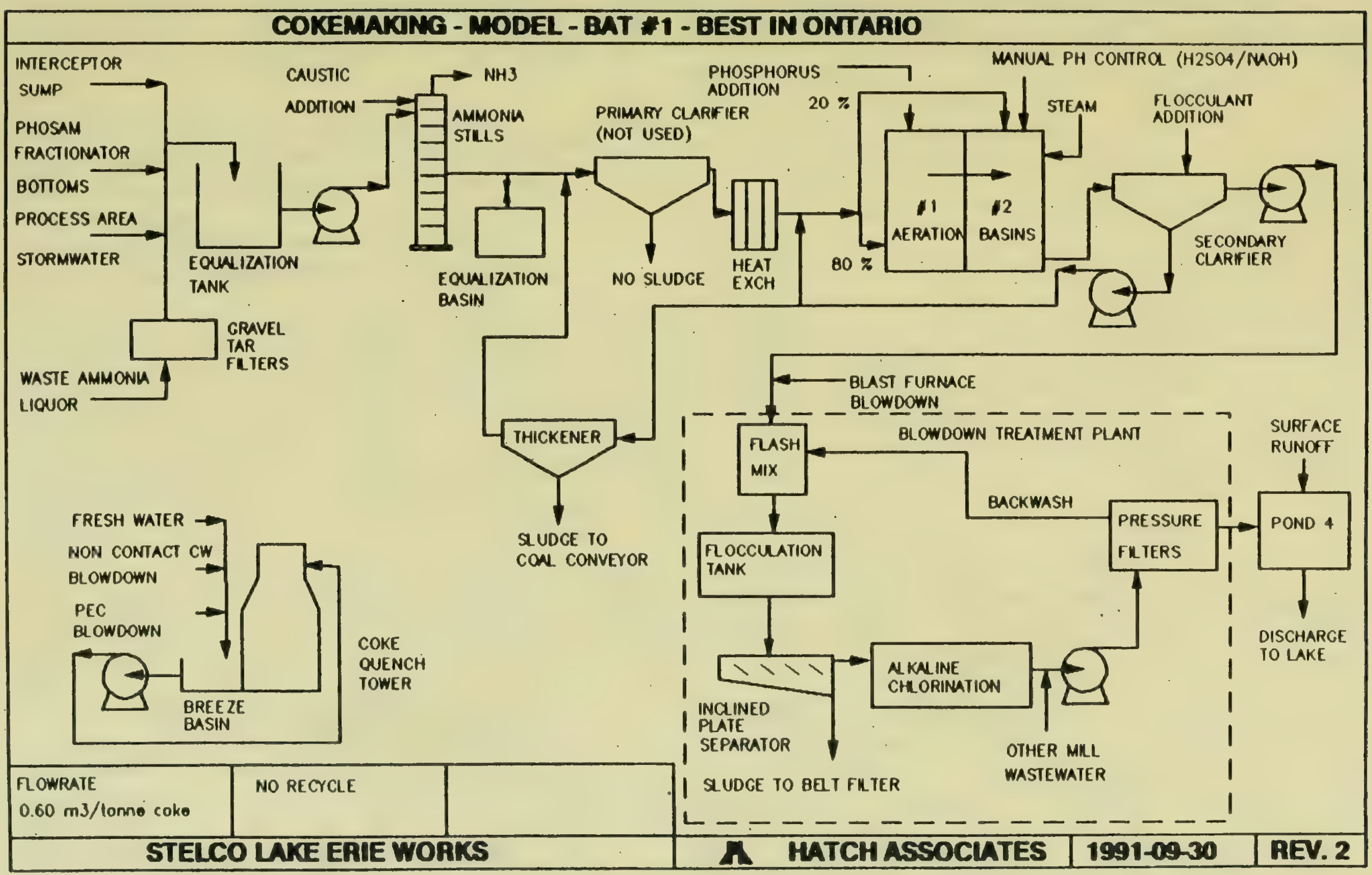
5.2.5 BAT #5 Virtual Elimination of Persistent Toxics

The BAT #3 Cokemaking wastewater treatment technology was determined to be the BAT #1 treatment process. This technology is detailed in section 5.2.1.

This wastewater stream is expected to contain very low levels of benzo(a)pyrene (persistent bioaccumulative) and other organic toxics. No demonstrated technologies are known to further reduce the concentrations of organic toxics. The precise scientific definition of "virtual elimination

of persistent toxics" is not established, but it is likely that this goal will be interpreted as zero discharge for persistent bioaccumulative toxics. Benzo(a)pyrene is listed in this category. No discharge to receiving water may be achieved with further treatment by ultrafiltration and ion exchange, or evaporation which may permit the treated water to be reused in other processes. However, these treatment technologies are not sufficiently demonstrated in this application. Activated Carbon is a demonstrated treatment process for reduction of organics but its effectiveness to completely remove very low levels of carbon based contaminants is not known.

Table 5.2.3, *Predicted Effluent Quality Integrated Mills - Cokemaking - Generic*, summarizes the effluent data for each model BAT option. The flow data and parameter loading data was used to develop the predicted effluent quality for the Applied BAT options for Cokemaking operations at Ontario Mills (see Volume II).



COKEMAKING - MODEL - BAT #1 - BEST IN ONTARIO
INTERCEPTOR SUMP
PHOSAM FRACTIONATOR BOTTOMS
PROCESS AREA
STORMWATER
WASTE AMMONIA LIQUOR
GRAVEL TAR FILTERS
EQUALIZATION TANK
CAUSTIC ADDITION
NH3
AMMONIA STILLS
EQUALIZATION BASIN
PRIMARY CLARIFIER (NOT USED)
NO SLUDGE
HEAT EXCH
PHOSPHORUS ADDITION
20 %
80 %
MANUAL PH CONTROL (H2S04/NAOH)
STEAM
#1 AERATION
#2 BASINS
FLOCCULANT ADDITION
SECONDARY CLARIFIER
THICKENER
SLUDGE TO COAL CONVEYOR
BLAST FURNACE BLOWDOWN
BLOWDOWN TREATMENT PLANT
FLASH MIX
BACKWASH
PRESSURE FILTERS
FLOCCULATION TANK
INCLINED PLATE SEPARATOR
SLUDGE TO BELT FILTER
ALKALINE CHLORINATION
OTHER MILL WASTEWATER
SURFACE RUNOFF
POND 4
DISCHARGE TO LAKE
FRESH WATER
NON CONTACT CW BLOWDOWN
PEC BLOWDOWN
BREEZE BASIN
COKE QUENCH TOWER
FLOWRATE
0.60 m3/tonne coke
NO RECYCLE
STELCO LAKE ERIE WORKS
HATCH ASSOCIATES
1991-09-30
REV. 2

FIGURE 5.2.1

COKEMAKING: INTEGRATED				BAT #1 – BEST IN ONTARIO					
			EFFLUENT DATA				PERIOD: NOV 1989 - JUL 1990		
PARAMETER	Avg Flow (m3/tonne)	EPA – BAT * Flow (m3/tonne)		Avg Flow (m3/day)	Max. Flow (m3/day)	Min Flow (m3/day)		# Samples	
Flow	0.60	0.64		961	–	–		–	
PARAMETER	Avg Load. (g/tonne)	EPA–40 CFR Avg. Load (g/tonne)	Avg Load. (kg/day)	Avg Conc'n (mg/L)	Max Conc'n (mg/L)	Min Conc'n (mg/L)	Reg. Meth. Det. Lim. (mg/L)	# Samples	# < DL
TSS (Note 2)	4.4	131	7.0	7.3	–	–	5	–	–
oil and grease	0.86	10.9	1.4	1.4	–	–	1	–	–
ammonia + ammonium (Note 2)	0.10	16	0.17	** 0.17	–	–	0.25	–	–
cyanide total	0.56	3.51	0.89	0.93	–	–	0.005	–	–
phenolics (4AAP)	0.0073	0.0319	0.012	0.012	–	–	0.002	–	–
benzene (Note 2)	0.0031	max 0.0319	0.0050	0.0052	–	–	0.0005	–	–
benzo(a)pyrene (Note 2)	0.0062	max 0.0319	0.010	0.010	–	–	0.0006	–	–
naphthalene (Note 2)	0.0037	max 0.0319	0.0060	0.0062	–	–	0.0016	–	–

SOURCE OF DATA: MISA MONITORING POINT 0400

* See EPA Development Document Iron and Steel

** less than RMDL

NOTE 1: Data disaggregated based on Stelco information.

NOTE 2: Concentrations of these compounds recorded at < RMDL in final effluent (MISA Point 0400).

NOTE 3: Avg. Conc'n = Avg. Load / Avg. Flow

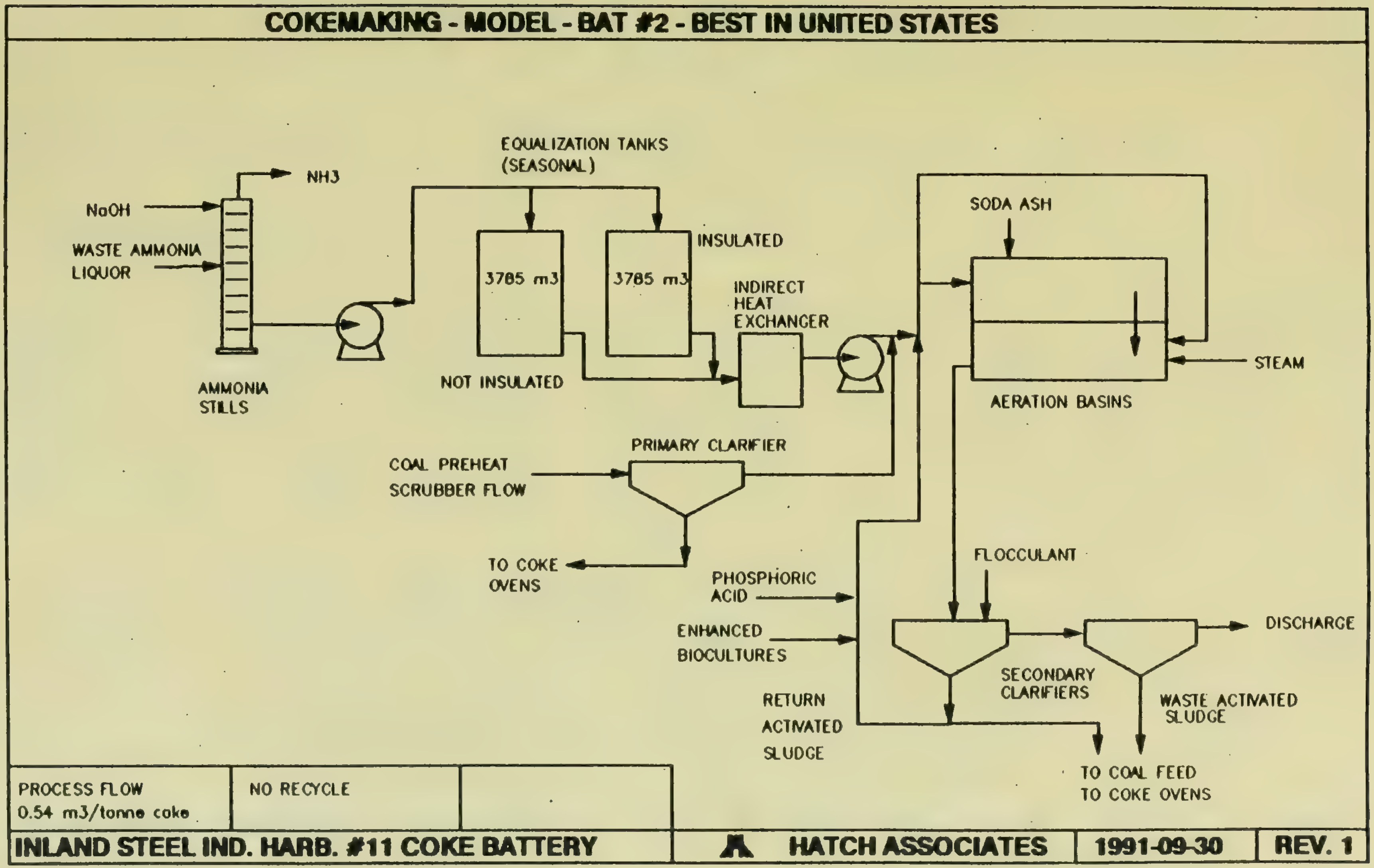

COKEMAKING - MODEL - BAT #2 - BEST IN UNITED STATES
EQUALIZATION TANKS
(SEASONAL)
NH3
NaOH
WASTE AMMONIA
LIQUOR
AMMONIA
STILLS
3785 m3
3785 m3
INSULATED
NOT INSULATED
INDIRECT
HEAT
EXCHANGER
SODA ASH
STEAM
AERATION BASINS
PRIMARY CLARIFIER
COAL PREHEAT
SCRUBBER FLOW
TO COKE
OVENS
PHOSPHORIC
ACID
ENHANCED
BIOCULTURES
FLOCCULANT
DISCHARGE
SECONDARY
CLARIFIERS
WASTE ACTIVATED
SLUDGE
RETURN
ACTIVATED
SLUDGE
TO COAL FEED
TO COKE OVENS
PROCESS FLOW
0.54 m3/tonne coke
NO RECYCLE
INLAND STEEL IND. HARB. #11 COKE BATTERY
HATCH ASSOCIATES
1991-09-30
REV. 1

FIGURE 5.2.2

COKEMAKING: INTEGRATED | BAT #2 – BEST IN THE UNITED STATES

COKEMAKING PROD'N (tonne/day)		1853	EFFLUENT DATA				PERIOD:	JUNE 1989 - JAN 1990	
PARAMETER	Avg Flow (m3/tonne)	EPA – BAT * Flow (m3/tonne)		Avg Flow (m3/day)	Max Flow (m3/day)	Min Flow (m3/day)		# Samples	
Flow	0.54	0.64		994	1499	269		235	
PARAMETER	Avg Load. (g/tonne)	EPA–40 CFR Avg. Load (g/tonne)	Avg Load. (kg/day)	Avg Conc'n (mg/L)	Max Conc'n (mg/L)	Min Conc'n (mg/L)	Lab. Meth. Det. Lim. (mg/L)	# Samples	# < LMDL
TSS	31	131	58	59	624	1.0	1.0	227	1
oil	0.69	10.9	1.3	1.3	3.0	1.0	1.0	105	12
ammonia + ammonium	0.93	16	1.7	1.7	24	0.010	0.01	225	0
total cyanide	3.6	3.51	6.7	6.9	26	0.0010	0.001	170	0
phenolics (4AAP)	0.022	0.0319	0.040	0.039	0.58	0.0030	0.001	222	0
benzene	0.0015	max 0.0319	0.0028	0.0030	0.060	0.0020	0.002	106	103
benzo(a)pyrene	0.011	max 0.0319	0.021	0.021	0.080	0.011	0.011	108	25
naphthalene	0.0058	max 0.0319	0.011	0.011	0.011	0.011	0.011	106	106

SOURCE OF DATA: PR58585.022

* See EPA Development Document Iron and Steel

NOTE: There is no Light Oil Recovery at Inland Steel, Indiana Harbor. The EPA flow allowance for Light Oil Recovery is 0.10 m3/tonne. This will be used for costing purposes only.

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – COKEMAKING – GENERIC

BAT	BAT #1		BAT #2		BAT #3	BAT #4	BAT #5
Mill	Stelco LEW (Note 1)		Inland Steel, IH (Note 2)				
Flow (m3/tonne)	0.60		0.54				
Parameter	Average Conc. (mg/L)	Average Loading (g/tonne)	Average Conc. (mg/L)	Average Loading (g/tonne)			
TSS (Note 5)	7.3	4.4	59	31			
oil and grease	1.4	0.86	1.3	0.69	See Bat #1 (Note 3).	(Note 4)	No demonstrated
ammonia + ammonium (Note 5)	* 0.17	0.10	1.7	0.93			technology in
cyanide total	0.93	0.56	6.9	3.6			this industry
phenolics (4AAP)	0.012	0.0073	0.039	0.022			sector.
benzene (Note 5)	0.0052	0.0031	0.0030	0.0015			
benzo(a)pyrene (Note 5)	0.010	0.0062	0.021	0.011			
naphthalene (Note 5)	0.0062	0.0037	0.011	0.0058			

Notes:
1. Data calculated by disaggregation of loadings from Misa Monitoring Point 0400, based on Stelco LEW information.
2. The BAT #2 flow (Inland, IH, 0.54 m3/tonne) does not include Light Oil Recovery. The EPA Dev. Doc. flow for Light Oil Recovery (0.10 m3/tonne) was added to BAT #2 flow for costing purposes.
3. LEW selected as BAT #3 as it emits lower discharges for 4 out of 5 parameters (excl. benzene, benzo(a)pyrene and naphthalene).
4. No specific toxicity data available. Based on review of toxic contaminants, effluent will be marginal to pass the Ontario Toxicity Test. No demonstrated technologies are known to further reduce (see BAT #5). This stream is combined with other streams prior to discharge; combined stream generally passed the Ontario Toxicity Test (see PEQ sheet Integrated Mills - Excluding Finishing - Stelco Lake Erie Works).
5. Compounds reported at < RMDL in final effluent (Stelco LEW MISA Monitoring Point 0400).

* less than RMDL

5.3 Integrated Mills - Sintering

5.3.1 BAT #1 Best in Ontario

As discussed in Section 5.1.2 only one of the integrated mills in Ontario includes sintering in its production processes. The other sinter plant at Wawa was not reviewed as part of this study. Since effluent data from only one sinter plant is available and it is integrated with ironmaking no BAT #1 is selected.

5.3.2 BAT #2 Best in the United States

This is included here only for comparison purposes. Several treatment technologies were determined to be the best available technology in the United States. Dry gas cleaning is used at Inland Steel, Indiana Harbor Works, in East Chicago, Indiana. There is no sintering wastewater from this process.

A combination of the US Steel Gary system and the Bethlehem Steel, Sparrows Point blowdown treatment system was chosen as the Model BAT #2 for sintering with wet gas cleaning. At US Steel Gary Works in Gary, Indiana the heavy solids are removed from the sintering wastewater in a classifier. The clarified water is then cooled and returned to the process. The blowdown from this system is disposed of on the slag. Due to the concern of the MOE that blowdown on slag may affect air quality and may create a contamination problem in slag utilization in road construction, an alternative system was chosen for treatment of the blowdown, the Bethlehem Steel, Sparrows Point System. The wastewater treatment at Bethlehem Steel in Sparrows Point, Maryland is similar to the treatment at US Steel Gary Works, except the blowdown is directed to the High Density Sludge (HDS) Treatment System. The blowdown is clarified in a reactor clarifier prior to discharge. The clarifier underflow is directed to a thickener with a small sludge stream recycled to the clarifier inlet for improved solids removal. Waste pickle liquor and polymer are added to the thickener to aid in settling. These treatment systems are shown schematically in Figure 5.3.1 *Sintering Model BAT #2 Best in the United States.*

The effluent sheet for US Steel Gary Works, Table 5.3.1, and the effluent data sheet for Bethlehem Steel, Sparrows Point, Table 5.3.2, are attached.

The order-of-magnitude capital and operating costs for the Model BAT #2 Sintering are $8 x 10^6 and $2 x 10^6 respectively.

The BAT #2 treatment technology recycles most of the sintering solids back to the sinter plant. This reduces the landfill requirements for the system. At US Steel's Gary Works facility the sintering wastewater treatment blowdown is evaporated on slag, however as discussed above this was not included as part of the Model. At Bethlehem Steel's Sparrows Point facility the wastewater is clarified prior to discharge. The solids collected must be disposed of in a landfill. In addition, the energy requirement of the process is increased with the added treatment facilities.

Dry gas cleaning of the sintering off gas may adversely affect air quality if the sulphur removal and mill scale oil removal technology is not as efficient as the wet gas cleaning technology.

5.3.3 BAT #3 Best at Selected World Locations

The best available technologies were determined to be the BAT #2 technologies described in section 5.3.2.

5.3.4 BAT #4 Non-Lethal

The BAT #3 Sintering wastewater treatment technology was determined to be the BAT #2 treatment process. This technology is detailed in section 5.3.2.

There is no specific toxicity data available for the Sintering wastewater stream. However, based on an assessment of the effluent characteristics, specifically the single contaminant LC50 values, the effluent is unlikely to pass the Ontario Toxicity Test by reason of the ammonia levels. Further treatment of the wastewater by oxidation of the ammonia would be required. This is shown schematically in Figure 5.3.2 *Sintering Model BAT #4 Non-Lethal*. This stream is not discharged directly to the receiving water, but is combined with other streams prior to discharge.

An alternative technology to achieve BAT #4 Non-Lethal would be a dry gas cleaning system as established at Inland Steel, Indiana Harbor Works.

5.3.5 BAT #5 Virtual Elimination of Persistent Toxics

The BAT #3 Sintering wastewater treatment technology was determined to be the BAT #2 treatment process. This technology is detailed in section 5.3.2.

There are generally no known persistent bioaccumulative toxics present in sinter plant effluent, however, there are other persistent toxics. No demonstrated technologies are known to further reduce the concentrations of the metal and organic toxics to lower levels than those measured in the wastewater stream. Virtual elimination of persistent toxics can only be assured by zero discharge. This may be achieved with further treatment by ultrafiltration and ion exchange, or evaporation which may permit the treated water to be recycled to the process. However, these treatment technologies are not demonstrated in this industrial sector.

An alternative technology to achieve BAT #5 Virtual Elimination would be a dry gas cleaning system as established at Inland Steel, Indiana Harbor Works.

Table 5.3.4, *Predicted Effluent Quality Integrated Mills - Sintering - Generic*, summarizes the effluent data for each Model BAT option. The flow data and parameter loading data was used to develop the predicted effluent quality for the Applied BAT for integrated sintering and ironmaking at Stelco Hilton (see Volume II).

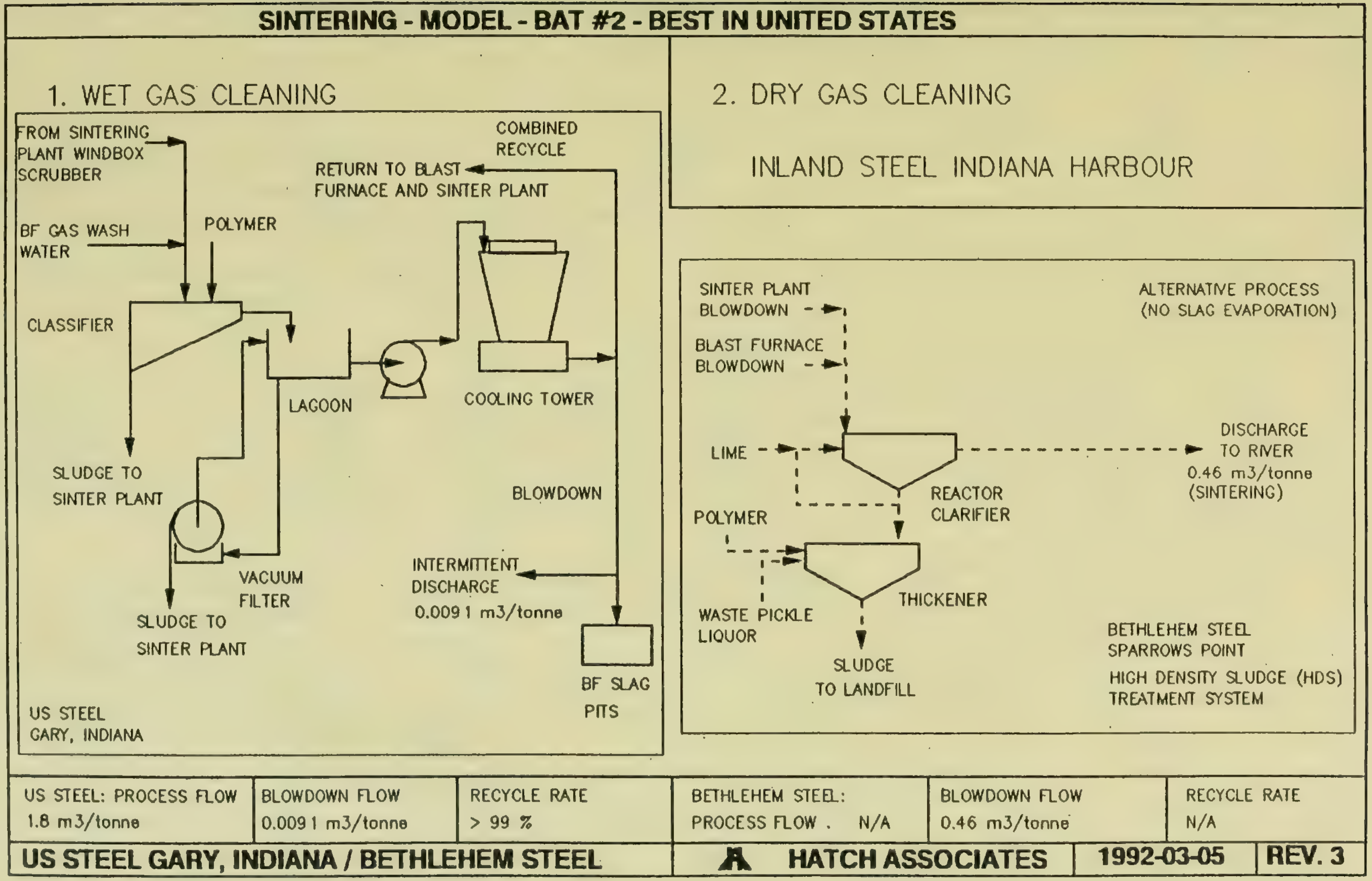

SINTERING - MODEL - BAT #2 - BEST IN UNITED STATES
1. WET GAS CLEANING
FROM SINTERING PLANT WINDBOX SCRUBBER
BF GAS WASH WATER
POLYMER
CLASSIFIER
COMBINED RECYCLE
RETURN TO BLAST FURNACE AND SINTER PLANT
LAGOON
COOLING TOWER
SLUDGE TO SINTER PLANT
BLOWDOWN
VACUUM FILTER
SLUDGE TO SINTER PLANT
INTERMITTENT DISCHARGE
0.009 1 m3/tonne
BF SLAG PITS
US STEEL
GARY, INDIANA
2. DRY GAS CLEANING
INLAND STEEL INDIANA HARBOUR
SINTER PLANT BLOWDOWN
BLAST FURNACE BLOWDOWN
ALTERNATIVE PROCESS (NO SLAG EVAPORATION)
LIME
DISCHARGE TO RIVER
0.46 m3/tonne (SINTERING)
REACTOR CLARIFIER
POLYMER
THICKENER
WASTE PICKLE LIQUOR
SLUDGE TO LANDFILL
BETHLEHEM STEEL
SPARROWS POINT
HIGH DENSITY SLUDGE (HDS) TREATMENT SYSTEM
US STEEL: PROCESS FLOW 1.8 m3/tonne
BLOWDOWN FLOW 0.009 1 m3/tonne
RECYCLE RATE > 99 %
BETHLEHEM STEEL: PROCESS FLOW . N/A
BLOWDOWN FLOW 0.46 m3/tonne
RECYCLE RATE N/A
US STEEL GARY, INDIANA / BETHLEHEM STEEL
HATCH ASSOCIATES
1992-03-05
REV. 3

FIGURE 5.3.1

SINTERING: INTEGRATED				BAT #2A – BEST IN THE UNITED STATES					
SINTERING PROD'N (tonne/day):		10187		EFFLUENT DATA			PERIOD:	Aug 1990 – Jan 1991	
PARAMETER	Avg Flow (m3/tonne)	EPA – BAT * Flow (m3/tonne)		Avg Flow (m3/day)	Max Flow (m3/day)	Min Flow (m3/day)		# Samples	
Flow	0.0091	0.50		93	-	-		-	
PARAMETER	Avg Load. (g/tonne)	EPA–40 CFR Avg. Load (g/tonne)	Avg Load. (kg/day)	Avg Conc'n (mg/L)	Max Conc'n (mg/L)	Min Conc'n (mg/L)	Lab. Meth. Det. Lim. (mg/L)	# Samples	# < LMDL
TSS	0.12	25	1.3	14	-	-	2.5	-	-
oil and grease	0.12	5.01	1.2	13	-	-	2.0	-	-
ammonia + ammonium	0.77	5.01	7.9	85	-	-	-	-	-
cyanide total	0.0019	1.50	0.020	0.21	-	-	0.005	-	-
phenolics (4AAP)	0.00011	0.0501	0.0012	0.012	-	-	0.005	-	-
lead	0.00050	0.150	0.0051	0.055	-	-	0.01	-	-
zinc	0.011	0.225	0.11	1.2	-	-	-	-	-

SOURCE OF DATA: PR#58585.014

- See EPA Development Document Iron and Steel

NOTE 1: Data disaggregated based on 25% of Flow and Mass Loadings (100% for oil). The remaining flow is ironmaking wastewater.

NOTE 2: Avg. Conc'n = Avg. Load / Avg. Flow

NOTE 3: Intermittent discharge. Blowdown evaporated on Slag.

US STEEL, GARY WORKS	TABLE 5.3.1	REV. #2	HATCH ASSOCIATES	1991-09-20

FILES: SNBAT2A.WK1 and SNBAT2A.ALL

SINTERING: INTEGRATED — BAT #2B – BEST IN THE UNITED STATES

SINTERING PROD'N (tonne/day): 8798

EFFLUENT DATA

PERIOD: *Jul 1990 – Dec 1990*

PARAMETER	Avg Flow (m3/tonne)	EPA - BAT * Flow (m3/tonne)		Avg Flow (m3/day)	Max Flow (m3/day)	Min Flow (m3/day)		# Samples	
Flow	0.46	0.50		4043	-	-		-	
PARAMETER	**Avg Load. (g/tonne)**	**EPA-40 CFR Avg. Load (g/tonne)**	**Avg Load. (kg/day)**	**Avg Conc'n (mg/L)**	**Max Conc'n (mg/L)**	**Min Conc'n (mg/L)**	**Lab. Meth. Det. Lim. (mg/L)**	**# Samples**	**# < LMDL**
TSS	4.0	25	35	8.6	-	-	-	-	-
oil and grease	2.7	5.01	24	5.9	-	-	-	-	-
ammonia + ammonium	28	5.01	250	62	-	-	-	-	-
cyanide total	0.064	1.50	0.56	0.14	-	-	-	-	-
phenolics (4AAP)	0.038	0.0501	0.34	0.083	-	-	-	-	-
lead	0.0087	0.150	0.076	0.019	-	-	-	-	-
zinc	0.091	0.225	0.80	0.20	-	-	-	-	-

SOURCE OF DATA: PR#58585.018

- See EPA Development Document Iron and Steel

NOTE 1: Data disaggregated based on 67% of Flow and Mass Loadings (100% for oil). The remaining flow is ironmaking wastewater.

NOTE 2: Avg. Conc'n = Avg. Load / Avg. Flow

NOTE 3: Continuous discharge. No slag evaporation.

BETHLEHEM STEEL, SPARROWS POINT	TABLE 5.3.2	REV. #2	HATCH ASSOCIATES	1992-02-12

FILES: SNBAT2B.WK1 and SNBAT2B.ALL

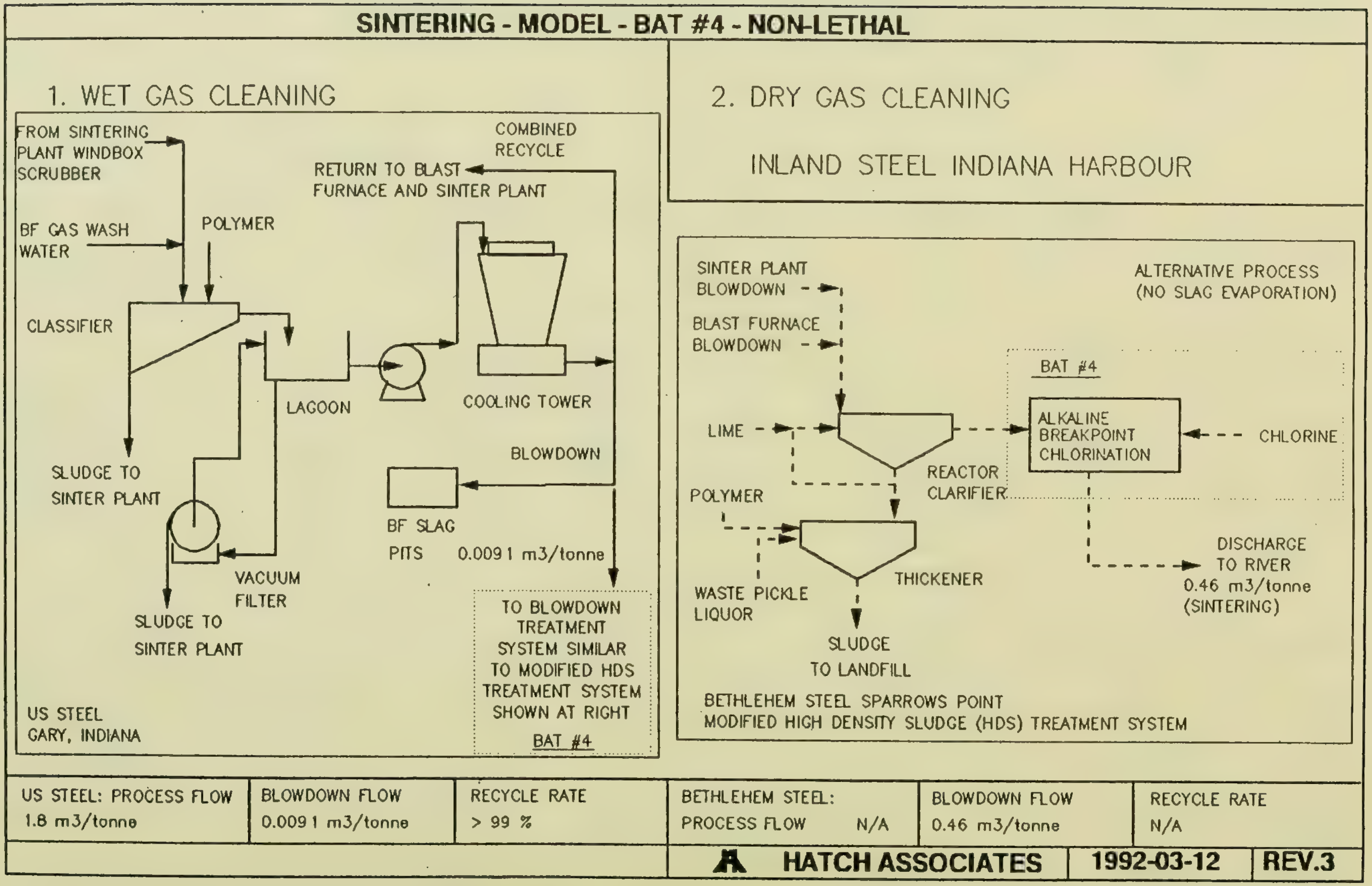

SINTERING - MODEL - BAT #4 - NON-LETHAL
1. WET GAS CLEANING
FROM SINTERING PLANT WINDBOX SCRUBBER
BF GAS WASH WATER
POLYMER
CLASSIFIER
SLUDGE TO SINTER PLANT
LAGOON
VACUUM FILTER
SLUDGE TO SINTER PLANT
COMBINED RECYCLE
RETURN TO BLAST FURNACE AND SINTER PLANT
COOLING TOWER
BLOWDOWN
BF SLAG PITS
0.0091 m3/tonne
TO BLOWDOWN TREATMENT SYSTEM SIMILAR TO MODIFIED HDS TREATMENT SYSTEM SHOWN AT RIGHT
BAT #4
US STEEL GARY, INDIANA
2. DRY GAS CLEANING
INLAND STEEL INDIANA HARBOUR
SINTER PLANT BLOWDOWN
BLAST FURNACE BLOWDOWN
LIME
POLYMER
WASTE PICKLE LIQUOR
REACTOR CLARIFIER
THICKENER
SLUDGE TO LANDFILL
ALTERNATIVE PROCESS (NO SLAG EVAPORATION)
BAT #4
ALKALINE BREAKPOINT CHLORINATION
CHLORINE
DISCHARGE TO RIVER
0.46 m3/tonne (SINTERING)
BETHLEHEM STEEL SPARROWS POINT
MODIFIED HIGH DENSITY SLUDGE (HDS) TREATMENT SYSTEM
US STEEL: PROCESS FLOW 1.8 m3/tonne
BLOWDOWN FLOW 0.0091 m3/tonne
RECYCLE RATE > 99 %
BETHLEHEM STEEL: PROCESS FLOW N/A
BLOWDOWN FLOW 0.46 m3/tonne
RECYCLE RATE N/A
HATCH ASSOCIATES
1992-03-12
REV.3

FIGURE 5.3.2

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – SINTERING – GENERIC

BAT	BAT #1	BAT #2A		BAT #2B		BAT #2C	BAT #3	BAT #4	BAT #5
Mill		US Steel, Gary (Note 1)		Bethlehem, S.P.(Note 2)		Inland, Ind. Harb.			
Flow (m3/tonne)		0.0091		0.46					
Parameter		Average Conc. (mg/L)	Average Loading (g/tonne)	Average Conc. (mg/L)	Average Loading (g/tonne)				
TSS		13	0.12	8.6	4.0		Wet Gas Cleaning	Wet Gas Cleaning	Wet Gas Cleaning
oil and grease	Not applicable.	13	0.12	5.9	2.7	Dry Gas	BAT #2A	Modified BAT #2A	No demonstrated
ammonia + ammonium		85	0.77	62	28	Cleaning,	or BAT #2B.	or modified BAT #2B	technology in
cyanide total		0.21	0.0019	0.14	0.064	no effluent.		(Note 3).	this industry sector.
phenolics (4AAP)		0.012	0.00011	0.083	0.038		Dry Gas Cleaning	Dry Gas Cleaning	Dry Gas Cleaning
lead		0.054	0.00050	0.019	0.0087		BAT #2C.	BAT #2C.	BAT #2C.
zinc		1.2	0.011	0.20	0.091				

Notes:
1. Intermittent discharge. Blowdown evaporated on Slag.
2. Continuous discharge. No slag evaporation.
3. There is no specific toxicity data available for BAT #2A or BAT #2B effluent streams. However it is unlikely that these streams would pass the Ontario Toxicity Test, principally due to ammonia levels. Further treatment by alkaline chlorination would reduce ammonia levels, which may result in these effluent streams passing the Ontario Toxicity Test. These streams do not discharge directly to the receiving water but are combined with other streams prior to discharge.

1992-02-12	TABLE 5.3.4	HATCH ASSOCIATES	PEQSNGEN.WK1 PEQSNGEN.ALL	REV. # 4

5.4 Integrated Mills - Ironmaking

5.4.1 BAT #1 Best in Ontario

The best Ironmaking wastewater treatment technology in Ontario was determined to be Stelco LEW. Wastewater from the Bischoff Scrubber is passed through two thickeners to allow the solids to settle. The water is then cooled and returned to the process except for a small blowdown stream. Part of the blowdown is evaporated on the slag while the remaining wastewater receives treatment by alkaline breakpoint chlorination and filtration at the Blowdown Treatment Plant prior to discharge. This treatment system is shown schematically in Figure 5.4.1 *Ironmaking Model BAT #1 Best in Ontario*.

The effluent data sheet for this treatment technology, Table 5.4.1, is attached.

The order-of-magnitude capital and operating costs for Model BAT #1 Ironmaking are $\$28 \times 10^6$ and $\$4 \times 10^6$ respectively.

In order to recycle the blast furnace off gas cleaning water the suspended solids must first be removed. These solids must be disposed of to a landfill site. At Lake Erie Works some of the blowdown from the system is directed to the slag pit for slag quenching. MOE has expressed concern that this practice may affect air quality and may create a contamination problem in slag utilization in road construction. In addition to these factors, the energy requirement for the ironmaking wastewater treatment system should be considered.

5.4.2 BAT #2 Best in the United States

The best available wastewater treatment technologies for Ironmaking in the United States were determined to be Inland Steel's Indiana Harbor facility and Bethlehem Steel's Sparrows Point facility. At Inland Steel Indiana Harbor the gas wash water is treated in two thickeners, cooled and recycled. The recycle system blowdown is evaporated on the slag. There is no wastewater discharged from this system. The wastewater treatment is similar at Bethlehem Steel Sparrows Point except the blowdown is directed to the High Density Sludge (HDS) Treatment System. The blowdown is clarified in a reactor clarifier prior to discharge. The clarifier underflow is directed to a thickener with a small sludge stream recycled to the clarifier inlet for improved solids removal. Waste pickle liquor and polymer are added to the thickener to aid in settling. The

treatment systems at the two facilities are shown in Figure 5.4.2 *Ironmaking Model BAT #2 Best in the United States*.

Very low cyanide levels are observed at Bethlehem S.P. The patented high density sludge system operates at high pH which may precipitate the cyanide.

The effluent data sheet for this treatment technology, Table 5.4.2, is attached.

The order-of-magnitude capital and operating costs for Model BAT #2 Ironmaking are $27 x 10^6 and $3 x 10^6 respectively.

The non water quality impacts of this system are the same as the BAT #1 impacts described in section 5.4.1.

5.4.3 BAT #3 Best at Selected World Locations

The best available technology was determined to be BAT #2, Inland Steel, Indiana Harbor since there is no effluent from this process. The treatment technology is described in section 5.4.2. If it is not acceptable to evaporate the system blowdown on slag, an alternative BAT #3 is Stelco's Lake Erie Works process. This is described in section 5.4.1.

MOE have advised HA that they will likely not approve evaporation on slag due to concerns relating to air emissions, and potential contamination from leachate of the slag used in road construction.

5.4.4 BAT #4 Non-Lethal

There is no specific toxicity data available for the ironmaking treated wastewater effluent stream. The technology demonstrated at Stelco LEW where the treated effluent from the ironmaking is further co-treated with other process streams through a chemical/physical blowdown treatment facility was found to be non-lethal most of the time.

5.4.5 BAT #5 Virtual Elimination of Persistent Toxics

The BAT #3 Ironmaking wastewater treatment technology was determined to be the BAT #2 treatment process. This technology is detailed in section 5.4.2. Inland Steel's Indiana Harbor Works facility has no wastewater attributed to the Ironmaking process as the blowdown from the system is evaporated on the slag. If it is not possible to evaporate the system blowdown on slag, BAT #1 is an alternative wastewater treatment technology. Ironmaking BAT #1 is described in section 5.4.1.

This wastewater stream from BAT #1 Stelco LEW is expected to contain very low levels (in some cases below the RMDL) of organic compounds. No demonstrated technologies are known to further reduce the concentrations of these compounds to lower levels. Virtual elimination of persistent toxics can only be assured by zero discharge. No discharge to receiving water may be achieved with further treatment by ultrafiltration and ion exchange, or evaporation which may permit the treated water to be recycled to the process. However, these treatment technologies are not demonstrated in this industrial sector.

Table 5.4.3, *Predicted Effluent Quality Integrated Mills - Ironmaking- Generic*, summarizes the effluent data for each Model BAT option. The flow data and parameter loading data was used to develop the predicted effluent quality for the Applied BAT options for Ironmaking at Ontario Mills (see Volume II).

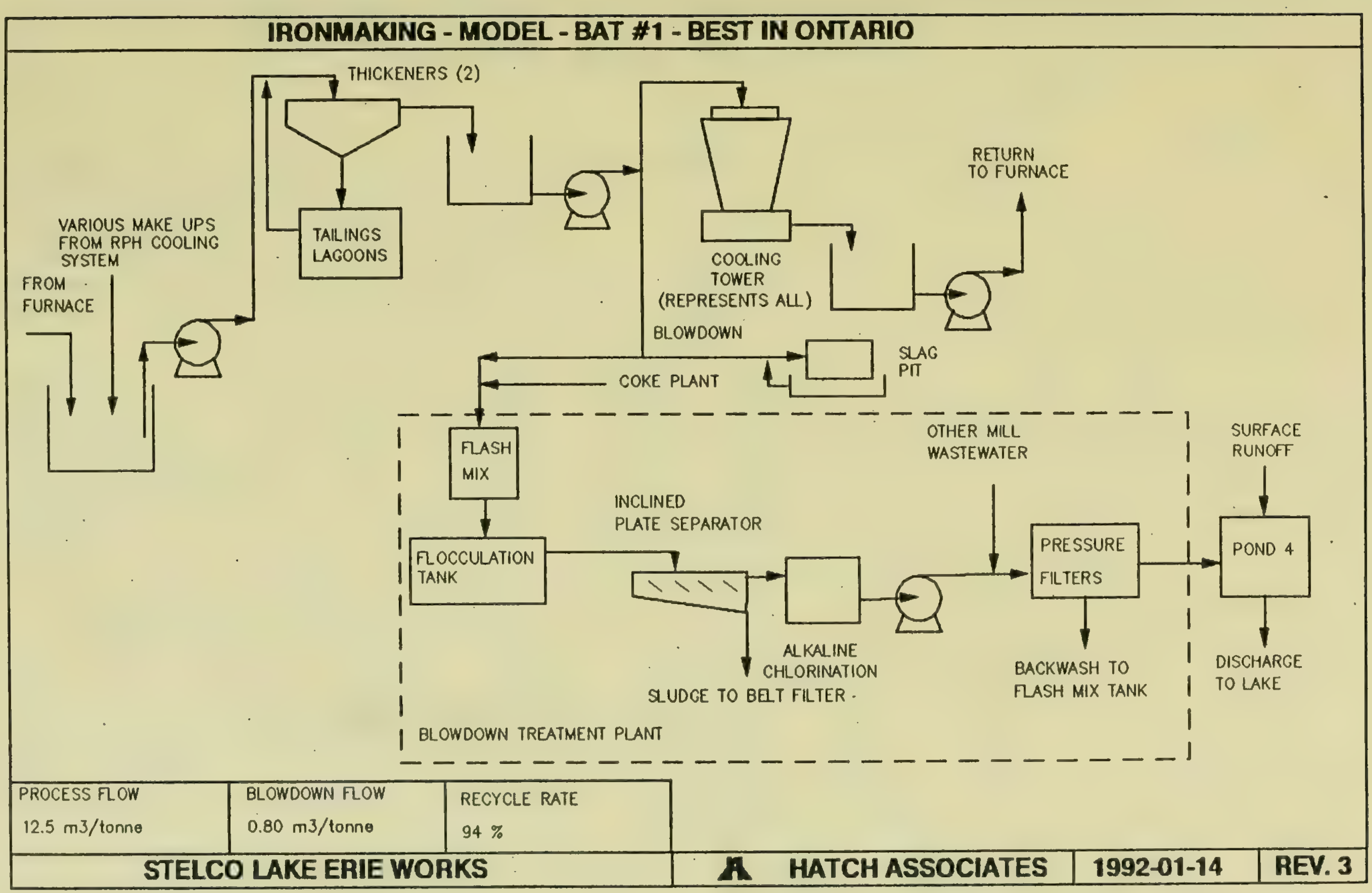

IRONMAKING - MODEL - BAT #1 - BEST IN ONTARIO
THICKENERS (2)
TAILINGS LAGOONS
VARIOUS MAKE UPS FROM RPH COOLING SYSTEM
FROM FURNACE
COOLING TOWER (REPRESENTS ALL)
RETURN TO FURNACE
BLOWDOWN
SLAG PIT
COKE PLANT
FLASH MIX
FLOCCULATION TANK
INCLINED PLATE SEPARATOR
ALKALINE CHLORINATION
SLUDGE TO BELT FILTER
OTHER MILL WASTEWATER
PRESSURE FILTERS
BACKWASH TO FLASH MIX TANK
BLOWDOWN TREATMENT PLANT
SURFACE RUNOFF
POND 4
DISCHARGE TO LAKE
PROCESS FLOW
12.5 m3/tonne
BLOWDOWN FLOW
0.80 m3/tonne
RECYCLE RATE
94 %
STELCO LAKE ERIE WORKS
HATCH ASSOCIATES
1992-01-14
REV. 3

FIGURE 5.4.1

IRONMAKING: INTEGRATED				BAT #1 – BEST IN ONTARIO					
			EFFLUENT DATA				PERIOD:	NOV 1989 - JUL 1990	
PARAMETER	Avg Flow (m3/tonne)	EPA - BAT * Flow (m3/tonne)		Avg Flow (m3/day)	Max Flow (m3/day)	Min Flow (m3/day)		# Samples	
Flow	0.80	0.29		2863	-	-		-	
PARAMETER	Avg Load. (g/tonne)	EPA-40 CFR Avg. Load (g/tonne)	Avg Load. (kg/day)	Avg Conc'n (mg/L)	Max Conc'n (mg/L)	Min Conc'n (mg/L)	Reg. Meth. Det. Lim. (mg/L)	# Samples	# < DL
TSS (Note 3)	3.9	26	14	** 4.9	-	-	5	-	-
oil and grease	-	-	-	-	-	-	-	-	-
ammonia + ammonium (Note 3)	0.41	2.92	1.5	0.52	-	-	0.25	-	-
cyanide total	0.37	0.876	1.3	0.47	-	-	0.005	-	-
phenolics (4AAP)	0.0098	0.0292	0.035	0.012	-	-	0.002	-	-
lead	0.018	0.0876	0.063	** 0.022	-	-	0.03	-	-
zinc	0.035	0.131	0.13	0.045	-	-	0.01	-	-

SOURCE OF DATA: MISA MONITORING MIDES #0400

* SOURCE: EPA Development Document Iron and Steel

** less than RMDL

NOTE 1: Data disaggregated based on Stelco information.

NOTE 2: Avg. Conc'n = Avg. Load / Avg. Flow

NOTE 3: Concentrations reported at less than RMDL in final effluent (MISA Point 0400).

STELCO STEEL, LAKE ERIE WORKS	TABLE 5.4.1	REV. #3	HATCH ASSOCIATES	1991-09-20

FILES: IRBAT1.WK1 and IRBAT1.ALL

IRONMAKING: INTEGRATED | BAT #2A – BEST IN THE UNITED STATES

EFFLUENT DATA

IRONMAKING PROD'N (tonne/day): 7636

PERIOD: *JUL 1990 – DEC 1990*

PARAMETER	Avg Flow (m3/tonne)	EPA – BAT * Flow (m3/tonne)		Avg Flow (m3/day)	Max Flow (m3/day)	Min Flow (m3/day)		# Samples	
Flow	0.26	0.29		1992	–	–		–	
PARAMETER	**Avg Load. (g/tonne)**	**EPA-40 CFR Avg. Load (g/tonne)**	**Avg Load. (kg/day)**	**Avg Conc'n (mg/L)**	**Max Conc'n (mg/L)**	**Min Conc'n (mg/L)**	**Lab. Meth. Det. Lim. (mg/L)**	**# Samples**	**# < LMDL**
TSS	2.2	26	17	8.6	–	–	–	–	–
oil and grease	–	–	–	–	–	–	–	–	–
ammonia + ammonium	16	2.92	123	62	–	–	–	–	–
cyanide total	0.036	0.876	0.28	0.14	–	–	–	–	–
phenolics (4AAP)	0.022	0.0292	0.17	0.083	–	–	–	–	–
lead	0.0049	0.0876	0.038	0.019	–	–	–	–	–
zinc	0.052	0.131	0.40	0.20	–	–	–	–	–

SOURCE OF DATA: PR#58585.018

* SOURCE: EPA Development Document Iron and Steel

NOTE 1: Data disaggregated based on Sintering and Ironmaking process blowdown flows for all parameters except oil and grease. The oil and grease loadings were attributed 100% to Sintering.

NOTE 2: Avg. Conc'n = Avg. Load / Avg. Flow

BETHLEHEM STEEL, SPARROWS POINT	TABLE 5.4.2	REV. #3	HATCH ASSOCIATES	1992-02-12

FILES: IRBAT2A.WK1 and IRBAT2A.ALL

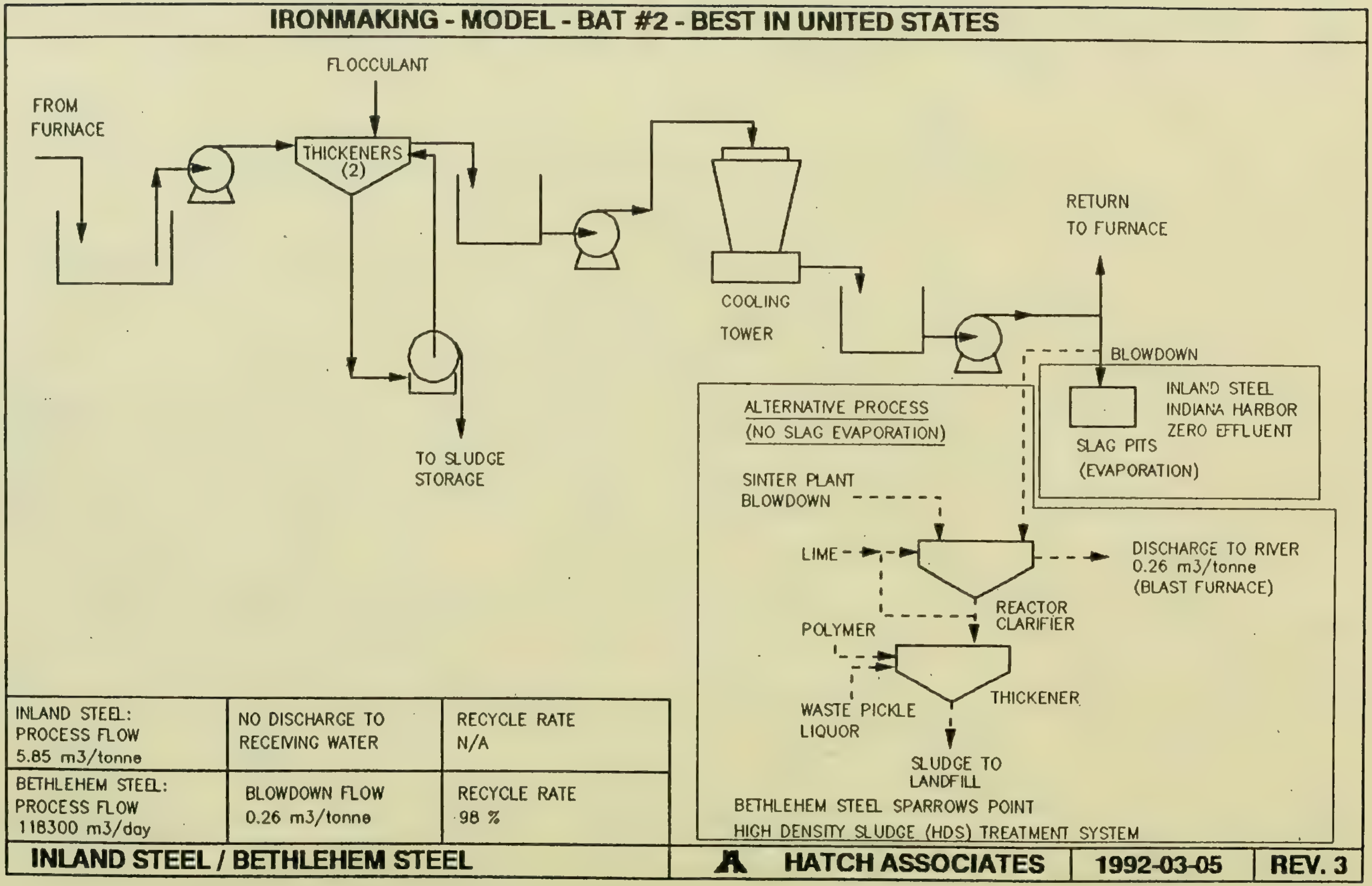

IRONMAKING - MODEL - BAT #2 - BEST IN UNITED STATES
FLOCCULANT
FROM FURNACE
THICKENERS (2)
TO SLUDGE STORAGE
COOLING TOWER
RETURN TO FURNACE
BLOWDOWN
INLAND STEEL
INDIANA HARBOR
ZERO EFFLUENT
SLAG PITS
(EVAPORATION)
ALTERNATIVE PROCESS
(NO SLAG EVAPORATION)
SINTER PLANT BLOWDOWN
LIME
DISCHARGE TO RIVER
0.26 m3/tonne
(BLAST FURNACE)
REACTOR CLARIFIER
POLYMER
THICKENER
WASTE PICKLE LIQUOR
SLUDGE TO LANDFILL
BETHLEHEM STEEL SPARROWS POINT
HIGH DENSITY SLUDGE (HDS) TREATMENT SYSTEM
INLAND STEEL: PROCESS FLOW 5.85 m3/tonne
NO DISCHARGE TO RECEIVING WATER
RECYCLE RATE N/A
BETHLEHEM STEEL: PROCESS FLOW 118300 m3/day
BLOWDOWN FLOW 0.26 m3/tonne
RECYCLE RATE 98 %
INLAND STEEL / BETHLEHEM STEEL
HATCH ASSOCIATES
1992-03-05
REV. 3

FIGURE 5.4.2

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – IRON MAKING – GENERIC

BAT	BAT #1		BAT #2A		BAT #2B	BAT #3	BAT #4	BAT #5
Mill	Stelco LEW (Note 1)		Bethlehem, S.P. (Note 2)		Inland Steel, Ind. Harb.			
Flow (m3/tonne)	0.80		0.26					
Parameter	Average Conc.	Average Loading	Average Conc.	Average Loading				
	(mg/L)	(g/tonne)	(mg/L)	(g/tonne)				
TSS (Note 6)	* 4.9	3.9	8.6	2.2				
oil and grease	-	-	-	-	Evaporation	BAT #1 or	(Note 5)	No demonstrated
ammonia + ammonium (Note 6)	0.52	0.41	62	16	on slag (Note 3).	BAT #2 - B		technology in
cyanide total	0.47	0.37	0.14	0.036		(Note 4).		this industry
phenolics (4AAP)	0.012	0.0098	0.083	0.022				sector.
lead	* 0.022	0.018	0.019	0.0049				
zinc	0.045	0.035	0.20	0.052				

Notes:
1. Data calculated by disaggregation of loadings from MIDES #0400, based on Stelco LEW information.
2. Data calculated by disaggregation based on information from Bethlehem, S.P.
3. Inland Steel, Indiana Harbour achieved zero disharge by evaporation of blowdown on Slag.
4. BAT #1 and BAT #2 - A both disaggregated. No major differences except Ammonia. Treatment trains are similar, except BAT #1 includes alkaline Chlorination Stage to reduce Ammonia and is therefore selected for BAT #3.
5. There is no specific toxicity data for this stream, however, the stream would be marginal to pass the Ontario Toxicity Test by reason of ammonia levels. This stream does not discharge directly to the receiving water but is cotreated with other streams to further remove ammonia and cyanide prior to discharge (see Predicted Effluent Quality - Integrated Mills - Excluding Finishing - Stelco LEW). The combined stream generally passes the Ontario Toxicity Test.
6. Compounds reported at <RMDL in final effluent (Stelco LEW MISA Point 0400).

* less than RMDL

1992-02-12	TABLE 5.4.3	HATCH ASSOCIATES	PEQIRGEN.WK1 PEQIRGEN.ALL	REV. # 4

5.5 Integrated Mills - Steelmaking

5.5.1 General

Steel is made in basic Oxygen Furnaces by two methods - open combustion in which sufficient air is drawn in to the furnace to fully convert carbon to carbon dioxide; and suppressed combustion in which oxygen supply to the furnace is limited to convert carbon to carbon monoxide (which is then used as fuel elsewhere).

The open combustion system off-gases are cleaned either by wet scrubbing (e.g. Algoma) or by dry methods - electrostatic precipitators (eg. Stelco Hilton). The suppressed combustion systems are typically wet gas cleaning (e.g. Stelco LEW), but dry gas cleaning is practised at Thyssen, Germany and Posco, Korea. However, these are not endorsed as Best Available Technology. Open combustion systems have much larger gas flows, and generally finer particulate than suppressed combustion systems. Larger volumes of scrubber water at higher pressures are required for open combustion systems.

5.5.2 BAT #1 Best in Ontario

The best available treatment technology in Ontario for Suppressed Combustion Steelmaking wet gas cleaning wastewater was determined to be Stelco LEW. This is shown schematically in Figure 5.5.1 *Steelmaking BOF Model BAT #1 Best in Ontario.* The gas scrubbing water is clarified in cyclone separators and the BOF thickener then recycled back to the venturi scrubber. The blowdown stream from this treatment process is directed to the Blowdown Treatment Plant for further clarification and filtration. The effluent data for this treatment technology is shown in Table 5.5.1. The order-of-magnitude capital and operating costs for Model BAT #1A suppressed combustion steelmaking are \$18 x 10^6 and \$2 x 10^6 respectively.

The best available technology for Open Combustion Steelmaking, wet gas cleaning cannot be identified due to lack of data. Dofasco's No. 1 Melt Shop has about 30% recycle but the effluent is combined with No. 2 Melt Shop effluent prior to the BOF clarifier. Algoma uses a once through system and both BOF shops discharge to thickener No. 1. Neither system would be considered modern.

Dry gas cleaning is practised at Stelco Hilton. This is an open combustion system, and therefore the Best Available Technology in Ontario. A level of particulate removal similar to the wet gas cleaning technology is achievable with the dry gas cleaning process. The order-of-magnitude capital and operating costs for Model BAT #1B Open Combustion Steelmaking dry gas cleaning are $\$47 \times 10^6$ and $\$3 \times 10^6$ respectively.

5.5.3 BAT #2 Best in the United States

The best available technology in the United States for suppressed combustion Steelmaking wet gas cleaning wastewater was determined to be LTV Steel Cleveland Works. This treatment system is shown in Figure 5.5.2 *Steelmaking BOF Suppressed Combustion Model BAT #2A Best in the United States*. The scrubbing water is treated in two classifiers operated in parallel followed by two thickeners also operated in parallel. The thickener overflow is recycled to the gas cleaning system. A dispersant is added to the water at the venturi scrubbers to minimize fouling. The blowdown from this system is directed to the continuous caster water treatment system. In order to maintain the high recycle rate, CO_2 is added at the classifiers to precipitate carbonates in the thickeners. Typical operating chemistry of the recycled water is shown below:

Total Hardness	15 mg/L
Carbonate Alkalinity	350 mg/L
OH^- Alkalinity	0-100 mg/L
Turbidity	< 50 NTU
pH	10.5

When the carbonate alkalinity exceeds 400 mg/L, the wastewater is blown down to the caster system. The effluent data sheet for this treatment technology, Table 5.5.2 Model BAT #2A, is attached. The order-of-magnitude capital and operating costs for Model BAT #2A Suppressed Combustion Steelmaking are $\$16 \times 10^6$ and $\$3 \times 10^6$ respectively.

CO_2 injection technology does not apply to treatment of wastewater from open combustion BOF shops. Therefore, Hatch has identified an alternate Model BAT #2B for Steelmaking with open combustion and wet gas cleaning. The alternate Model BAT #2B is the NO. 4 BOF shop at Inland Steel, Indiana Harbour. This treatment system is shown schematically in Figure 5.5.3.

The effluent data sheet for Steelmaking open combustion, Table 5.5.3 Model BAT #2B, is attached. The order-of-magnitude capital and operating costs for Model BAT #2B Steelmaking Open Combustion are $24 x 10^6 and $7 x 10^6 respectively.

As shown in Volume II, Steelmaking Model BAT #2A for suppressed combustion systems has been applied to Stelco LEW and to the No. 2 Melt Shop at Dofasco. Steelmaking Model BAT #2B for open combustion systems has been applied to Dofasco's No. 1 Melt Shop and to Algoma's No. 1 and No. 2 melt shops.

Some open combustion mills utilise dry or "semi-wet" (US EPA designation) gas cleaning systems. Examples would be Bethlehem Steel, Bethlehem Works, Gulf States Steel and Warren Consolidated. These systems are selected as BAT #2C.

5.5.4 BAT #3 Best in Selected World Locations

The best available technology for wet gas cleaning of BOF steelmaking suppressed combustion off-gas was determined to be LTV Steel Cleveland Works. This treatment technology is described in Section 5.5.3. The best available technology for BOF open combustion was determined to be Stelco Hilton. This treatment technology is described in Section 5.5.2.

Inland Steel, Indiana Harbor, the BAT #2B mill for open combustion systems with wet gas cleaning, achieves very low emission levels using a high rate recycle system. This mill may be considered BAT #3 for mills with open combustion steelmaking and wet gas cleaning. A modern well operated high rate recycle system achieves very low levels of emissions. Retrofit of a dry gas cleaning system at high cost to achieve zero discharge would not be reasonable for mills with existing wet gas cleaning facilities.

5.5.5 BAT #4 Non-Lethal

The BAT #3 treatment technology for Steelmaking suppressed combustion was determined to be the BAT #2A treatment process which has wet gas cleaning. This technology is detailed in section 5.5.3.

There is no specific toxicity data available for the Steelmaking wastewater stream. However, based on an assessment of the effluent characteristics, specifically the single contaminant LC50 values, the effluent is likely to pass the Ontario Toxicity Test depending on hardness. No demonstrated technologies are known to further reduce the zinc concentration to a lower level than measured in the wastewater stream. However, this stream is not discharged directly to the receiving water. The intermittent blowdown stream at LTV is discharged to the Continuous Caster. The wastewaters are then combined with other streams prior to discharge.

An alternative technology to achieve BAT #4 Non-Lethal is dry gas cleaning as established at Stelco Hilton.

5.5.6 BAT #5 Virtual Elimination of Persistent Toxics

The Best Available Technology #3 for suppressed combustion Steelmaking wastewater was determined to be the BAT #2A treatment process. This technology is detailed in section 5.5.3.

The Steelmaking wastewater stream is not expected to contain any persistent bioaccumulative toxics, however, the stream is expected to contain low levels of lead and zinc. No demonstrated technologies are known to further reduce the concentrations of these compounds. Virtual elimination of persistent toxics can only be assured by zero discharge. This may be achieved with further treatment by ultrafiltration and ion exchange, or evaporation which may permit the treated water to be recycled to the process. However, these treatment technologies are not demonstrated in this industrial sector.

An alternative technology to achieve BAT #5 Virtual Elimination is dry gas cleaning as established at Stelco Hilton Works.

Table 5.5.4, *Predicted Effluent Quality Integrated Mills - Steelmaking- Generic*, summarizes the effluent data for each Model BAT option. The flow data and parameter loading data was used to develop the predicted effluent quality for the Applied BAT options for Steelmaking at Ontario's Integrated Mills (see Volume II).

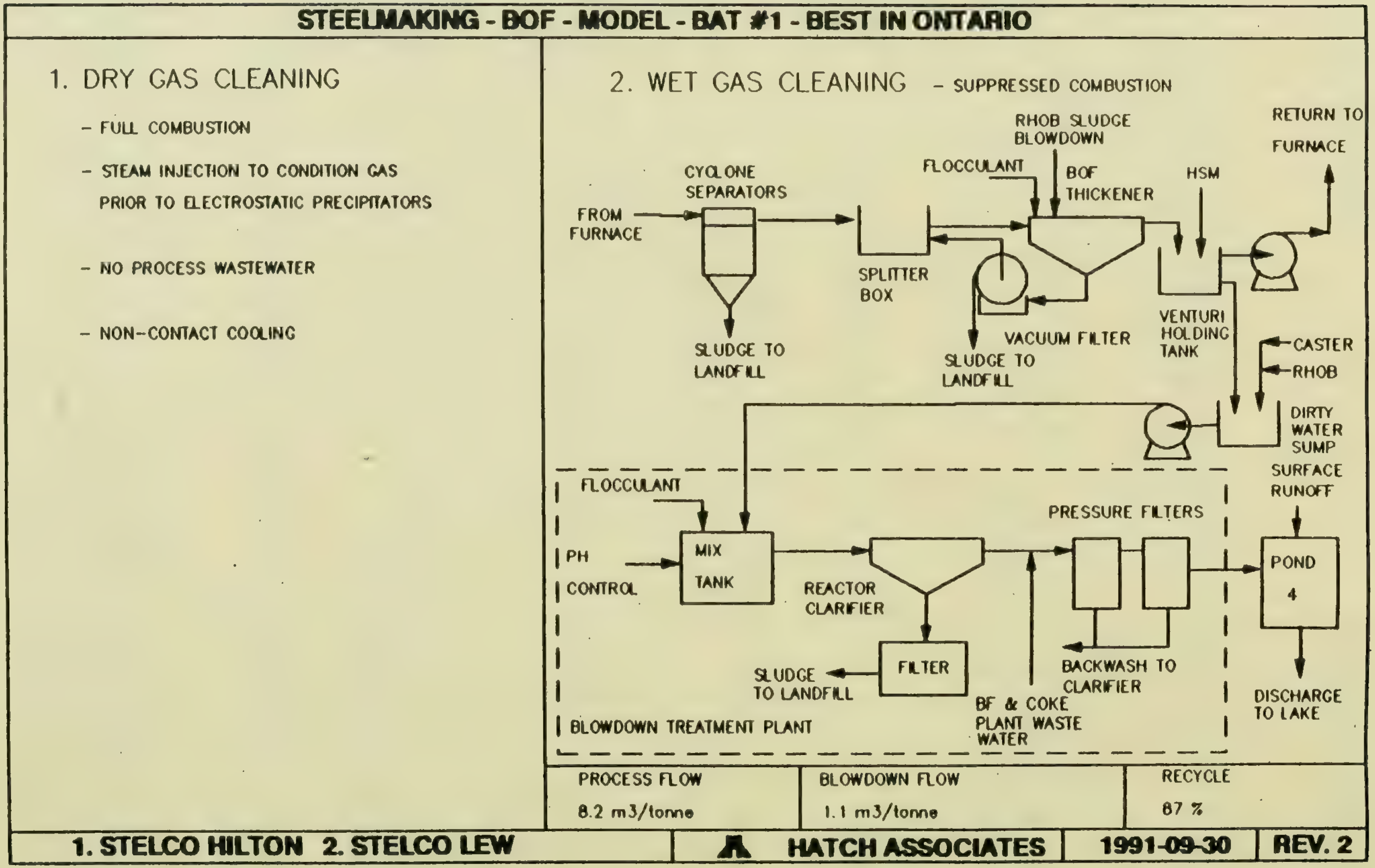

STEELMAKING - BOF - MODEL - BAT #1 - BEST IN ONTARIO
1. DRY GAS CLEANING
- FULL COMBUSTION
- STEAM INJECTION TO CONDITION GAS PRIOR TO ELECTROSTATIC PRECIPITATORS
- NO PROCESS WASTEWATER
- NON-CONTACT COOLING
2. WET GAS CLEANING - SUPPRESSED COMBUSTION
FROM FURNACE
CYCLONE SEPARATORS
SLUDGE TO LANDFILL
SPLITTER BOX
FLOCCULANT
RHOB SLUDGE BLOWDOWN
BOF THICKENER
VACUUM FILTER
SLUDGE TO LANDFILL
HSM
VENTURI HOLDING TANK
RETURN TO FURNACE
CASTER
RHOB
DIRTY WATER SUMP
SURFACE RUNOFF
POND 4
DISCHARGE TO LAKE
FLOCCULANT
PH CONTROL
MIX TANK
REACTOR CLARIFIER
FILTER
SLUDGE TO LANDFILL
BF & COKE PLANT WASTE WATER
PRESSURE FILTERS
BACKWASH TO CLARIFIER
BLOWDOWN TREATMENT PLANT
PROCESS FLOW
8.2 m3/tonne
BLOWDOWN FLOW
1.1 m3/tonne
RECYCLE
87 %
1. STELCO HILTON 2. STELCO LEW
HATCH ASSOCIATES
1991-09-30
REV. 2

FIGURE 5.5.1

STEELMAKING BOF (WET SUPP. COMB.): INTEGRATED — BAT #1 – BEST IN ONTARIO

EFFLUENT DATA

PERIOD: *NOV 1989 – JUL 1990*

PARAMETER	Avg Flow (m3/tonne)	EPA - BAT * Flow (m3/tonne)		Avg Flow (m3/day)	Max Flow (m3/day)	Min Flow (m3/day)		# Samples	
Flow	1.1	0.21		4784	-	-		-	
PARAMETER	**Avg Load. (g/tonne)**	**EPA-40 CFR Avg. Load (g/tonne)**	**Avg Load. (kg/day)**	**Avg Conc'n (mg/L)**	**Max Conc'n (mg/L)**	**Min Conc'n (mg/L)**	**Reg. Meth. Det. Lim. (mg/L)**	**# Samples**	**# < DL**
TSS (Note 4)	5.5	10.4	23	** 4.9	-	-	5	-	-
oil and grease	-	-	-	-	-	-	1	-	-
lead	0.11	0.0626	0.44	0.093	-	-	0.03	-	-
zinc	0.21	0.0939	0.89	0.19	-	-	0.01	-	-

SOURCE OF DATA: MISA MONITORING MIDES #0400

* SOURCE: EPA Development Document Iron and Steel, BOF Steelmaking Wet Suppressed Combustion.

** less than RMDL

NOTE 1: Data disaggregated based on Stelco information.

NOTE 2: Avg. Conc'n = Avg. Load / Avg. Flow

NOTE 3: Stelco LEW has Wet Gas Cleaning, Suppressed Combustion.

NOTE 4: Compound reported at < RMDL in final effluent (MISA Point 0400).

STELCO STEEL, LAKE ERIE WORKS	TABLE 5.5.1	REV. #2	HATCH ASSOCIATES	1991-09-20

FILES: SMBAT1.WK1 and SMBAT1.ALL

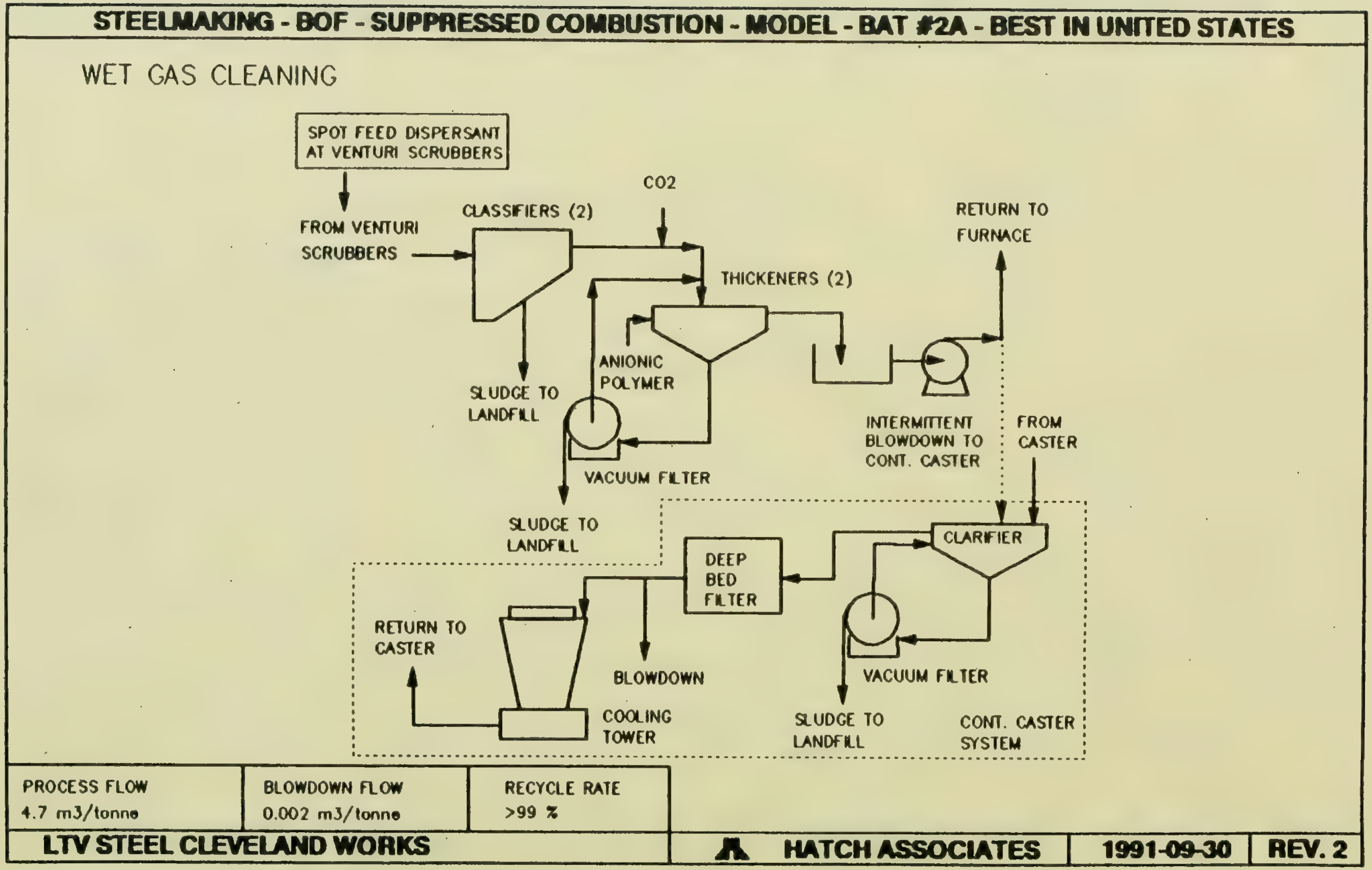

STEELMAKING - BOF - SUPPRESSED COMBUSTION - MODEL - BAT #2A - BEST IN UNITED STATES
WET GAS CLEANING
SPOT FEED DISPERSANT AT VENTURI SCRUBBERS
FROM VENTURI SCRUBBERS
CLASSIFIERS (2)
CO2
THICKENERS (2)
RETURN TO FURNACE
SLUDGE TO LANDFILL
ANIONIC POLYMER
VACUUM FILTER
SLUDGE TO LANDFILL
INTERMITTENT BLOWDOWN TO CONT. CASTER
FROM CASTER
CLARIFIER
DEEP BED FILTER
RETURN TO CASTER
BLOWDOWN
COOLING TOWER
VACUUM FILTER
SLUDGE TO LANDFILL
CONT. CASTER SYSTEM
PROCESS FLOW
4.7 m3/tonne
BLOWDOWN FLOW
0.002 m3/tonne
RECYCLE RATE
>99 %
LTV STEEL CLEVELAND WORKS
HATCH ASSOCIATES
1991-09-30
REV. 2

FIGURE 5.5.2

STEELMAKING BOF (WET SUPP. COMB.)				BAT #2A – BEST IN THE UNITED STATES					
STEELMAKING PROD'N (tonne/day):		7673	EFFLUENT DATA				PERIOD:	JAN 1990 - DEC 1990	
PARAMETER	Avg Flow (m3/tonne)	EPA – BAT * Flow (m3/tonne)		Avg Flow (m3/day)	Max Flow (m3/day)	Min Flow (m3/day)		# Samples	
Flow	0.0020	0.21		15	–	–		–	
PARAMETER	Avg Load. (g/tonne)	EPA–40 CFR Avg. Load (g/tonne)	Avg Load. (kg/day)	Avg Conc'n (mg/L)	Max Conc'n (mg/L)	Min Conc'n (mg/L)	Lab. Meth. Det. Lim. (mg/L)	# Samples	# < LMDL
TSS	0.0083	10.4	0.0636	4.2	–	–	1.0	–	–
oil and grease	–	–	–	–	–	–	–	–	–
lead	0.000057	0.0626	0.00044	0.029	–	–	0.025	–	–
zinc	0.00036	0.0939	0.0028	0.18	–	–	0.05	–	–

SOURCE OF DATA: PR#58585.25 (Outfall 017)

* SOURCE: EPA Development Document Iron and Steel, BOF Steelmaking Wet Suppressed Combustion

NOTE 1: Data disaggregated based on flow (0.8% of total; 0% for oil and grease). The remaining flow is Continuous Casting wastewater.

NOTE 2: Avg. Conc'n = Avg. Load / Avg. Flow

NOTE 3: LTV Cleveland has intermittent discharge of steelmaking process wastewater.

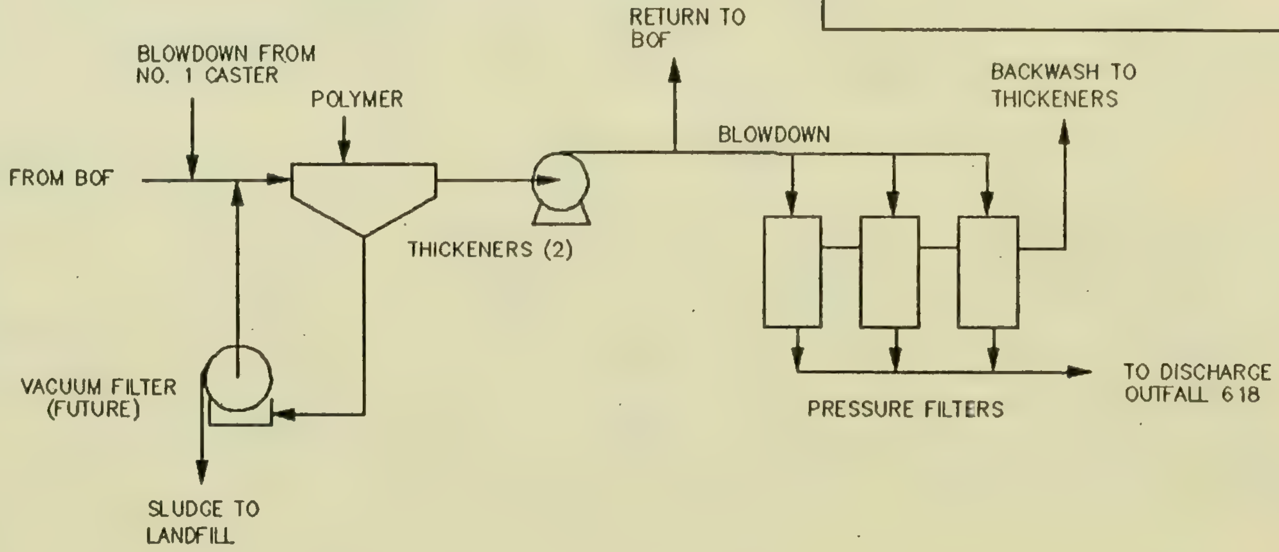
NOTE 4: LTV Cleveland has two BOF Wet Supp. Comb. and two BOF Semi-Wet (no wastewater).

LTV, CLEVELAND WORKS	TABLE 5.5.2	REV. #2	HATCH ASSOCIATES	1991-09-20

FILES: SMBAT2A.WK1 and SMBAT2A.ALL

STEELMAKING - BOF - OPEN COMBUSTION - MODEL - BAT #2B - BEST IN UNITED STATES

WET GAS CLEANING



DRY GAS CLEANING

SEE BAT #1B – SIMILAR SYSTEM AT SEVERAL MILLS, SOME WITH MINIMAL WATER DISCHARGE FROM GAS CONDITIONING.

PROCESS FLOW	BLOWDOWN FLOW	RECYCLE RATE
N/A	0.24 m3/tonne	N/A

INLAND STEEL INDIANA HARBOR WORKS | HATCH ASSOCIATES | 1992-03-11 | REV. 3

FIGURE 5.5.3

STEELMAKING BOF (WET OPEN COMB.) — BAT #2B – BEST IN THE UNITED STATES

STEELMAKING PROD'N (tonne/day): 6689

EFFLUENT DATA

PERIOD: *MAY 1989 – JAN 1990*

PARAMETER	Avg Flow *(m3/tonne)*	EPA – BAT * Flow *(m3/tonne)*		Avg Flow *(m3/day)*	Max Flow *(m3/day)*	Min Flow *(m3/day)*		# Samples	
Flow	0.24	0.46		1625	–	–		–	
PARAMETER	**Avg Load. *(g/tonne)***	**EPA–40 CFR Avg. Load *(g/tonne)***	**Avg Load. *(kg/day)***	**Avg Conc'n *(mg/L)***	**Max Conc'n *(mg/L)***	**Min Conc'n *(mg/L)***	**Lab. Meth. Det. Lim. *(mg/L)***	**# Samples**	**# < LMDL**
TSS	0.72	22.9	4.8	3.0	–	–	1.0	–	–
oil and grease	–	–	–	–	–	–	–	–	–
lead	0.014	0.138	0.093	0.059	–	–	0.05	–	–
zinc	0.027	0.207	0.18	0.12	–	–	0.05	–	–

SOURCE OF DATA: PR#58585.022 (Outfall 618, No. 4 BOF and No. 1 Continuous Caster)

* SOURCE: EPA Development Document Iron and Steel, BOF Steelmaking Wet Open Combustion

NOTE 1: Data disaggregated based on flow (76.8% of total; 0% for oil and grease). The remaining flow is Continuous Casting wastewater.

NOTE 2: Avg. Conc'n = Avg. Load / Avg. Flow

NOTE 3: Inland Steel, Indiana Harbor has two BOF shops using open (full) combustion steelmaking.

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – STEELMAKING – GENERIC

BAT	BAT #1A		BAT #1B	BAT #2A		BAT #2B		BAT #2C	BAT #3A	BAT #3B	BAT #4	BAT #5
Mill	Stelco LEW (Note 1)		Stelco Hilton	LTV Cleveland (Note 2)		Inland, IH (Note 3)		(Note 4)	LTV Cleveland	Stelco Hilton		
Flow (m3/tonne)	1.1			0.0020		0.24		Open Comb.	Supp. Comb.	Open Comb.	Supp. Comb.	Supp. Comb.
Parameter	Average	Average	No effluent;	Average	Average	Average	Average	Dry Gas Cl.	Wet Gas Cleaning	Dry Gas Cl.	Note 5	No demonst.
	Conc.	Loading	Dry Gas Cl.	Conc.	Loading	Conc.	Loading		See BAT #2A	See BAT #1B	or	technology in
	(mg/L)	(g/tonne)	Open Comb.	(mg/L)	(g/tonne)	(mg/L)	(g/tonne)			or	Open Comb.	this industry
TSS (Note 6)	* 4.9	5.5		4.2	0.0083	3.0	0.72			See BAT #2B	Dry Gas Cl.	sector.
oil and grease	-	-		-	-	-	-					or
lead	0.093	0.11		0.029	0.000057	0.059	0.014					Open Comb.
zinc	0.19	0.21		0.18	0.00036	0.12	0.027					Dry Gas Cl.

Notes:
1. Data calculated by disaggregation of loadings from MISA Monitoring Point 0400, based on Stelco LEW information. Stelco LEW has suppressed combustion, wet gas cleaning.
2. LTV Cleveland has intermittent discharge of steelmaking process waste water. Their Steelmaking operations include two furnaces with suppressed combustion, wet gas cleaning and 2 furnaces with semi-wet gas cleaning. Data disaggregated based on flow (0.8% of total; 0% for oil and grease). The remaining flow is Continuous Casting wastewater.
3. Inland, Indiana Harbor has open combustion steelmaking with wet gas cleaning.
4. Examples: Bethlehem Steel, Bethlehem, Gulf States Steel, Warren Consolidated.
5. There is no specific toxicity data available for these streams (BAT #3-A). These streams may pass the Ontario Toxicity Test depending on hardness. Wastewater treatment to further reduce the zinc level is not demonstrated technology. BAT #2A is not discharged directly to the receiving water. It has an intermittent blowdown to the Continuous Caster which is then combined with other streams prior to discharge.
6. Compound reported at < RMDL in final effluent (Stelco LEW MISA Point 0400).

* less than RMDL

1992-03-13	TABLE 5.5.4	HATCH ASSOCIATES	PEQSMGEN.WK1 PEQSMGEN.ALL	REV. # 4

5.6 Integrated Mills - Continuous Casting

5.6.1 BAT #1 Best in Ontario

The wastewater treatment technology at Stelco LEW was deemed to be the best available technology in Ontario. The treatment system is shown in Figure 5.6.1 *Continuous Casting Model BAT #1 Best in Ontario*. The water from the caster flows to a scale pit for removal of large solids. The water is then pumped through sand filters, cooled in a cooling tower and returned to the process. The backwash from the sand filters is directed to the blowdown treatment plant for clarification and filtration prior to discharge.

The effluent data sheet, Table 5.6.1, for this treatment technology is attached.

The order-of-magnitude capital and operating costs for Model BAT #1 Continuous Casting are $\$13 \times 10^6$ and $\$3 \times 10^6$ respectively.

5.6.2 BAT #2 Best in the United States

The best available treatment technology in the United States for Continuous Casting wastewater was determined to be Inland Steel, Indiana Harbour Works. The treatment system consisted of a scalping pit, scale pit with oil skimming, pressure sand filters and a cooling tower. A small blowdown flow is discharged from this system. The backwash from the pressure filters is returned to the scale pit. The treatment system is shown schematically in Figure 5.6.2 *Continuous Casting Model BAT #2 Best in the United States*.

The effluent data sheet, Table 5.6.2 for this treatment technology is attached.

The order-of-magnitude capital and operating costs for Model BAT #2 Continuous Casting are $\$8 \times 10^6$ and $\$4 \times 10^6$ respectively.

5.6.3 BAT #3 Best at Selected World Locations

The best available technology was determined to be Inland Steel's, Indiana Harbour Works facility. The treatment technology is described in section 5.6.2.

5.6.4 BAT #4 Non-Lethal

The BAT #3 Continuous Casting wastewater treatment technology was determined to be the BAT #2 treatment process. This technology is detailed in section 5.6.2.

There is no specific toxicity data available for the Continuous Casting wastewater stream. However, based on an assessment of the effluent characteristics, specifically the single contaminant LC50 values, the effluent may pass the Ontario Toxicity Test depending on hardness and dissolved solids. No demonstrated technologies are known to further reduce the zinc concentration to a lower level than measured in the wastewater stream. However, this stream is not discharged directly to the receiving water, but is combined with other streams prior to discharge.

5.6.5 BAT #5 Virtual Elimination of Persistent Toxics

The BAT #3 Continuous Casting wastewater treatment technology was determined to be the BAT #2 treatment process. This technology is detailed in section 5.6.2.

The Continuous Casting wastewater stream is not expected to contain any persistent bioaccumulative toxics, however, the stream is expected to contain low levels of lead and zinc. No demonstrated technologies are known to further reduce the concentrations of these compounds. Virtual elimination of persistent toxics can only be assured by zero discharge. This may be achieved with further treatment by ultrafiltration and ion exchange, or evaporation which may permit the treated water to be recycled to the process. However, these treatment technologies are not demonstrated in this industrial sector.

Table 5.6.3, *Predicted Effluent Quality Integrated Mills - Continuous Casting - Generic*, summarizes the effluent data for each Model BAT option. The flow data and parameter loading data was used to develop the predicted effluent quality for the Applied BAT Options for Continuous Casting at Ontario's Integrated Mills (see Volume II).

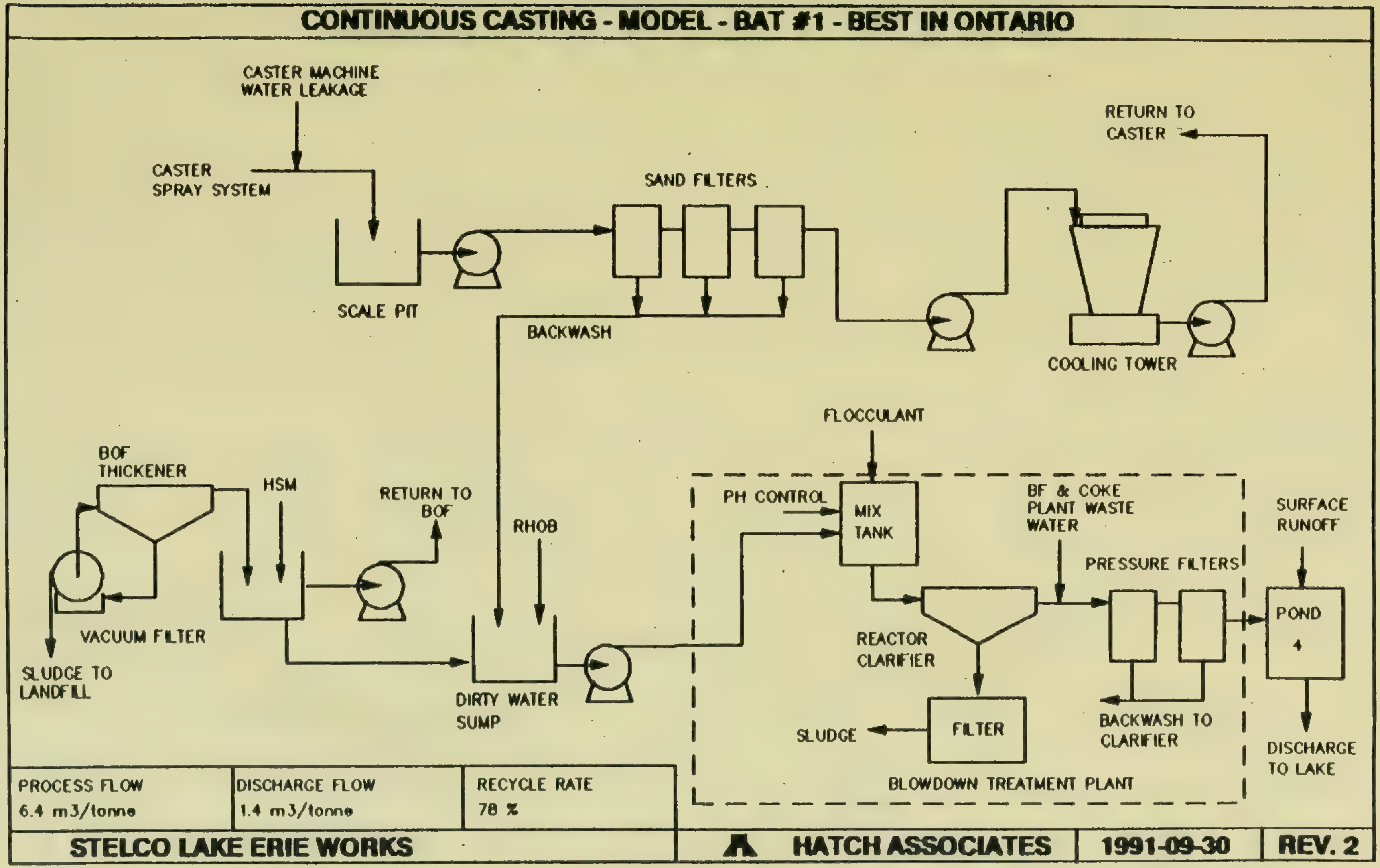

CONTINUOUS CASTING - MODEL - BAT #1 - BEST IN ONTARIO
CASTER MACHINE WATER LEAKAGE
CASTER SPRAY SYSTEM
SCALE PIT
SAND FILTERS
BACKWASH
RETURN TO CASTER
COOLING TOWER
FLOCCULANT
BOF THICKENER
HSM
RETURN TO BOF
RHOB
VACUUM FILTER
SLUDGE TO LANDFILL
DIRTY WATER SUMP
PH CONTROL
MIX TANK
BF & COKE PLANT WASTE WATER
PRESSURE FILTERS
SURFACE RUNOFF
POND 4
REACTOR CLARIFIER
FILTER
SLUDGE
BACKWASH TO CLARIFIER
DISCHARGE TO LAKE
BLOWDOWN TREATMENT PLANT
PROCESS FLOW 6.4 m3/tonne
DISCHARGE FLOW 1.4 m3/tonne
RECYCLE RATE 78 %
STELCO LAKE ERIE WORKS
HATCH ASSOCIATES
1991-09-30
REV. 2

FIGURE 5.6.1

CONTINUOUS CASTING: INTEGRATED — BAT #1 – BEST IN ONTARIO

EFFLUENT DATA

PERIOD: NOV 1989 - JUL 1990

PARAMETER	Avg Flow (m3/tonne)	EPA - BAT * Flow (m3/tonne)		Avg Flow (m3/day)	Max Flow (m3/day)	Min Flow (m3/day)		# Samples	
Flow	1.4	0.10		5745	-	-		-	
PARAMETER	**Avg Load. (g/tonne)**	**EPA-40 CFR Avg. Load (g/tonne)**	**Avg Load. (kg/day)**	**Avg Conc'n (mg/L)**	**Max Conc'n (mg/L)**	**Min Conc'n (mg/L)**	**Reg. Meth. Det. Lim. (mg/L)**	**# Samples**	**# < DL**
TSS (Note 4)	6.6	26	28	** 4.9	-	-	5	-	-
oil and grease	2.0	7.8	8.3	1.4	-	-	1	-	-
lead (Note 3)	-	0.0313	-	-	-	-	0.03	-	-
zinc (Note 3)	-	0.0469	-	-	-	-	0.01	-	-

SOURCE OF DATA: MISA MONITORING MIDES #0400

* See EPA Development Document Iron and Steel

** less than RMDL

NOTE 1: Data disaggregated based on Stelco information.

NOTE 2: Avg. Conc'n = Avg. Load / Avg. Flow

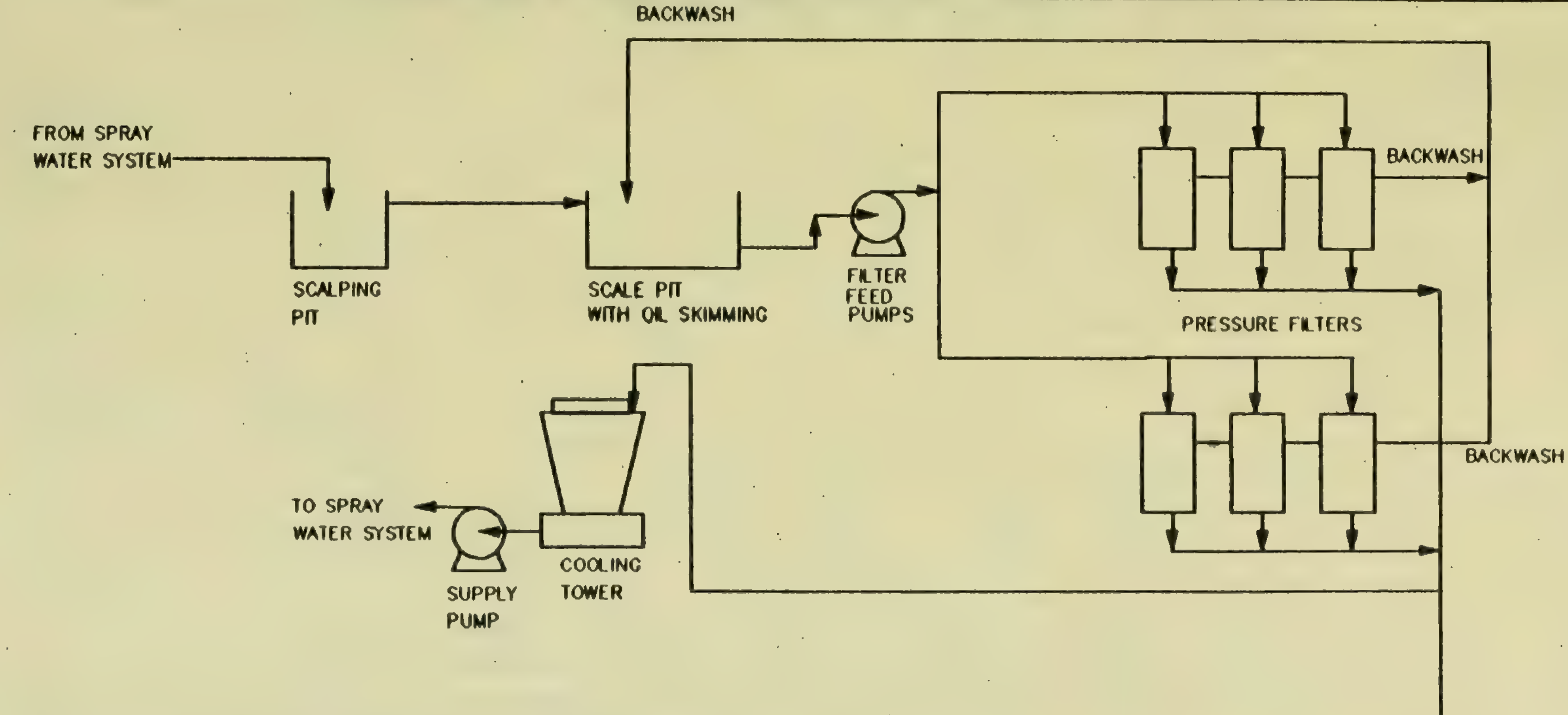
NOTE 3: Low levels of lead and zinc will be present, but no data is available.

NOTE 4: Compound reported at < RMDL in final effluent (MISA Point 0400).

STELCO STEEL, LAKE ERIE WORKS | TABLE 5.6.1 | REV. #1 | HATCH ASSOCIATES | 1991-09-20

FILES: CCBAT1.WK1 and CCBAT1.ALL

CONTINUOUS CASTING - MODEL - BAT #2 - BEST IN UNITED STATES



NOTE : U.S. STEEL, GARY, INDIANA ACHIEVES A NET DISCHARGE FLOW OF 0.031 m3/tonne, EQUIVALENT TO A RECYCLE OF > 99%. NO DATA AVAILABLE – INTERNAL STREAM.

PROCESS FLOW	BLOWDOWN FLOW	RECYCLE
12.5 m3/tonne	0.076 m3/tonne	>99 %

INLAND STEEL INDIANA HARBOR	HATCH ASSOCIATES	1991-05-27	REV. 0

FIGURE 5.6.2

CONTINUOUS CASTING: INTEGRATED | BAT #2 – BEST IN THE UNITED STATES

CONT. CAST. PROD'N (tonne/day): 5374

EFFLUENT DATA

PERIOD: MAY 1989 - JAN 1990

PARAMETER	Avg Flow (m3/tonne)	EPA - BAT * Flow (m3/tonne)		Avg Flow (m3/day)	Max Flow (m3/day)	Min Flow (m3/day)		# Samples	
Flow	0.076	0.10		408	3289	0		196	
PARAMETER	**Avg Load. (g/tonne)**	**EPA-40 CFR Avg. Load (g/tonne)**	**Avg Load. (kg/day)**	**Avg Conc'n (mg/L)**	**Max Conc'n (mg/L)**	**Min Conc'n (mg/L)**	**Lab. Meth. Det. Lim. (mg/L)**	**# Samples**	**# < LMDL**
TSS	1.4	26	7.7	21	627	2.0	1.0	192	0
oil	0.16	7.8	0.85	1.8	6.0	1.0	1.0	120	7
lead	0.0087	0.0313	0.047	0.13	4.6	0.05	0.05	196	127
zinc	0.0080	0.0469	0.043	0.11	0.85	0.04	0.05	196	41

SOURCE OF DATA: PR#58585.022, No. 2 Caster (Outfall 609)

- * See EPA Development Document Iron and Steel

INLAND STEEL, INDIANA HARBOR | TABLE 5.6.2 | REV. #1 | HATCH ASSOCIATES | 1991-09-20

FILES: CCBAT2.WK1 and CCBAT2.ALL

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – CONTINUOUS CASTING – GENERIC

BAT	BAT #1		BAT #2		BAT #3		BAT #4		BAT #5	
Mill	Stelco LEW (Notes 1,2)		Inland Steel, Ind. Harb.							
Flow (m3/tonne)	1.4		0.076							
Parameter	Average Conc. (mg/L)	Average Loading (g/tonne)	Average Conc. (mg/L)	Average Loading (g/tonne)	Average Conc. (mg/L)	Average Loading (g/tonne)	Average Conc. (mg/L)	Average Loading (g/tonne)	Average Conc. (mg/L)	Average Loading (g/tonne)
TSS (Note 4)	* 4.9	6.6	21	1.4					No demonstrated	
oil and grease	1.4	2.0	1.8	0.16	See BAT #2.		Note 3		technology in	
lead	-	-	0.13	0.0087					this industry	
zinc	-	-	0.11	0.0080					sector.	

Notes: 1. Data calculated by disaggregation of loadings from MISA Monitoring Point 0400, based on Stelco LEW information.

2. Low levels of lead and zinc will be present in the Continuous Caster wastewater at Stelco LEW. No data available.

3. There is no specific toxicity data available for this stream. However, this stream may pass the Ontario Toxicity Test depending on hardness and dissolved solids. Wastewater technology to further reduce zinc levels is not demonstrated technology. This stream is not discharged directly to the receiving water, but is combined with other streams prior to discharge.

4. Compound reported at < RMDL in final effluent (Stelco LEW MISA Point 0400).

* less than RMDL

1991-09-20	TABLE 5.6.3	HATCH ASSOCIATES	PEQCCGEN.WK1 PEQCCGEN.ALL	REV. # 3

5.7 Integrated Mills - Hot Forming

The United States EPA did not promulgate BAT limits for Hot Forming because compliance with Best Practicable Technology (BPT) limits resulted in a non-toxic effluent. The EPA BPT limits relating to Model BAT #1 and Model BAT #2, which are both carbon steel hot strip mills, are shown in the effluent data sheets for these mills. The EPA BPT limits for each type of hot forming operation are shown in Table 5.7.1 *EPA Hot Forming BPT Effluent Limits*. As shown in the table, the maximum allowable flow is 11 m^3/tonne for flat mills, hot strip and sheet and the minimum allowable flow is 2.5 m^3/tonne for flat mills, specialty plate.

5.7.1 BAT #1 Best in Ontario

The best available treatment technology in Ontario for Hot Forming wastewater was determined to be Stelco LEW. Water from the hot strip mill flows to a lagoon with two oil removal systems. The water is then filtered, cooled and returned to the process. The backwash from the sand filters is cascaded to the BOF wet gas cleaning system for solids removal. The backwash serves as the only blowdown of process water from the system. This treatment system is shown schematically in Figure 5.7.1 *Hot Forming Model BAT #1 Best in Ontario*.

The effluent data sheet, Table 5.7.2 for this treatment technology is attached.

The order-of-magnitude capital and operating costs for Model BAT #1 Hot Forming are \$30 x 10^6 and \$6 x 10^6 respectively.

5.7.2 BAT #2 Best in the United States

The best Hot Forming wastewater treatment technology in the United States was determined to be US Steel, Gary Works in Gary, Indiana. The process water flows to scale pits for the removal of heavy solids and oil. The water is then filtered, cooled and returned to the mill. There is a small blowdown flow from this system. The backwash from the sand filters is returned to the scale pits after passing through a thickener for solids and oil removal. The treatment system is shown schematically in Figure 5.7.2 *Hot Forming Model BAT #2 Best in the United States*.

The effluent data sheet, Table 5.7.3 for this treatment technology is attached.

The order-of-magnitude capital and operating costs for Model BAT #2 Hot Forming are $\$32 \times 10^6$ and $\$10 \times 10^6$ respectively.

5.7.3 BAT #3 Best at Selected World Locations

The best available technology was determined to be US Steel's, Gary Works facility. The treatment technology is described in section 5.7.2.

5.7.4 BAT #4 Non-Lethal

The BAT #3 Hot Forming wastewater treatment technology was determined to be the BAT #2 treatment process. This technology is detailed in section 5.7.2.

There is no specific toxicity data available for the BAT #3 Hot Forming wastewater stream. However, based on toxicity testing during the MISA monitoring period at Algoma (No. 2 Tube Mill), Dofasco (No. 2 Hot Mill), Stelco (No. 3 Bloom & Billet Mill) and USEPA toxicity testing of similar streams, the effluent is considered very likely to pass the Ontario Toxicity Test. This stream is not discharged directly to the receiving water, but is combined with other streams prior to discharge.

5.7.5 BAT #5 Virtual Elimination of Persistent Toxics

The BAT #3 Hot Forming wastewater treatment technology was determined to be the BAT #2 treatment process. This technology is detailed in section 5.7.2.

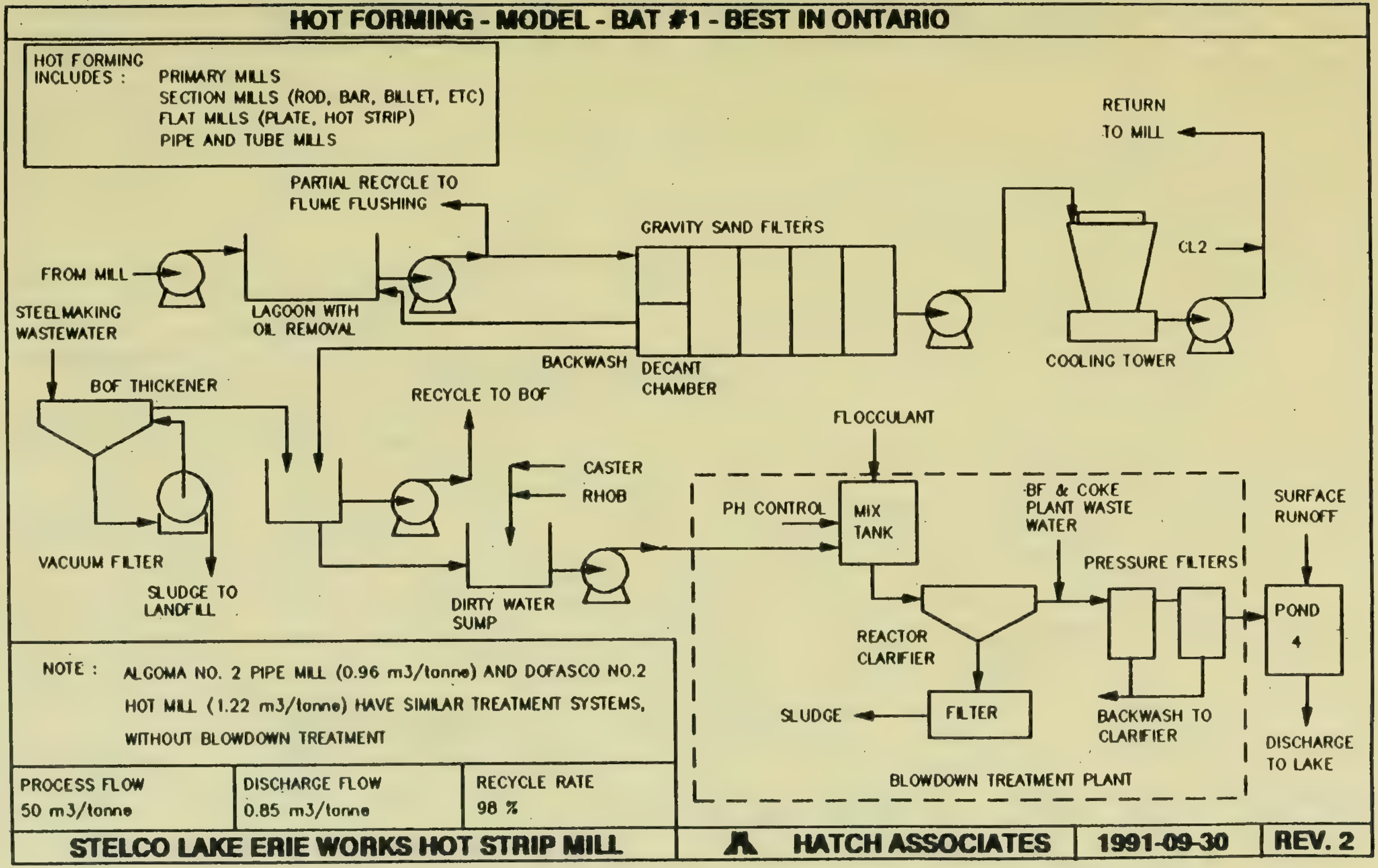
Hot forming wastewater streams do not normally contain toxic metals or organics. Virtual elimination of persistent toxics is therefore not a requirement in this case and BAT #5 is not applicable.

Table 5.7.4, *Predicted Effluent Quality Integrated Mills - Hot Forming - Generic*, summarizes the effluent data for each Model BAT option. The flow data and parameter loading data was used to develop the predicted effluent quality for the Applied BAT options for Hot Forming at Ontario's Integrated Mills (see Volume II).

TABLE 5.7.1: EPA HOT FORMING BPT EFFLUENT LIMITS

HOT FORMING OPERATION	DISCHARGE FLOW (m3/tonne)	TSS (g/tonne)		OIL AND GREASE (g/tonne)	
		MAX	AVG	MAX	AVG
Primary – Carbon w/o Scarfing	3.7	150	56.1	37.4	--
Primary – Specialty w/o Scarfing	3.7	150	56.1	37.4	--
Primary – Carbon with Scarfing	5.5	221	83.0	55.3	--
Primary – Specialty with Scarfing	5.5	221	83.0	55.3	--
Section – Carbon	8.9	357	134	89.4	--
Section – Specialty	5.6	224	84.1	56.1	--
Flat – Carbon Hot Strip & Sheet	11.0	427	160	107	--
Flat – Specialty Hot Strip & Sheet	11.0	427	160	107	--
Flat – Carbon Plate	5.7	227	85.1	56.8	--
Flat – Specialty Plate	2.5	100	37.6	25.0	--
Pipe & Tube – Carbon	5.3	212	79.5	53.0	--
Pipe & Tube – Specialty	5.3	212	79.5	53.0	--

Files: EPA.WK1 and EPA.ALL



HOT FORMING - MODEL - BAT #1 - BEST IN ONTARIO
HOT FORMING INCLUDES : PRIMARY MILLS
SECTION MILLS (ROD, BAR, BILLET, ETC)
FLAT MILLS (PLATE, HOT STRIP)
PIPE AND TUBE MILLS
PARTIAL RECYCLE TO FLUME FLUSHING
FROM MILL
LAGOON WITH OIL REMOVAL
GRAVITY SAND FILTERS
RETURN TO MILL
CL2
COOLING TOWER
STEELMAKING WASTEWATER
BOF THICKENER
BACKWASH
DECANT CHAMBER
RECYCLE TO BOF
FLOCCULANT
CASTER
RHOB
PH CONTROL
MIX TANK
BF & COKE PLANT WASTE WATER
SURFACE RUNOFF
PRESSURE FILTERS
POND 4
VACUUM FILTER
SLUDGE TO LANDFILL
DIRTY WATER SUMP
REACTOR CLARIFIER
SLUDGE
FILTER
BACKWASH TO CLARIFIER
DISCHARGE TO LAKE
BLOWDOWN TREATMENT PLANT
NOTE : ALGOMA NO. 2 PIPE MILL (0.96 m3/tonne) AND DOFASCO NO.2 HOT MILL (1.22 m3/tonne) HAVE SIMILAR TREATMENT SYSTEMS, WITHOUT BLOWDOWN TREATMENT
PROCESS FLOW 50 m3/tonne
DISCHARGE FLOW 0.85 m3/tonne
RECYCLE RATE 98 %
STELCO LAKE ERIE WORKS HOT STRIP MILL
HATCH ASSOCIATES
1991-09-30
REV. 2

FIGURE 5.7.1

HOT FORMING: INTEGRATED — BAT #1 – BEST IN ONTARIO

EFFLUENT DATA

PERIOD: *NOV 1989 – JUL 1990*

PARAMETER	Avg Flow (m3/tonne)	EPA - BPT * Flow (m3/tonne)		Avg Flow (m3/day)	Max Flow (m3/day)	Min Flow (m3/day)		# Samples	
Flow	0.85	11		2863	-	-		-	
PARAMETER	**Avg Load. (g/tonne)**	**EPA - BPT ** Avg. Load (g/tonne)**	**Avg Load. (kg/day)**	**Avg Conc'n (mg/L)**	**Max Conc'n (mg/L)**	**Min Conc'n (mg/L)**	**Reg. Meth. Det. Lim. (mg/L)**	**# Samples**	**# < DL**
TSS (Note 3)	4.2	160	14	*** 4.9	-	-	5.0	-	-
oil and grease	5.3	max 107	18	6.3	-	-	1.0	-	-

SOURCE OF DATA: MISA MONITORING MIDES #0400

* See EPA Development Document Iron and Steel

** See EPA 40 CFR – Part 420.72 (c)(1) Flat Mills – Hot Strip and Sheet Mills, Carbon

*** less than RMDL

NOTE 1: Data disaggregated based on Stelco information.

NOTE 2: Avg. Conc'n = Avg. Load / Avg. Flow

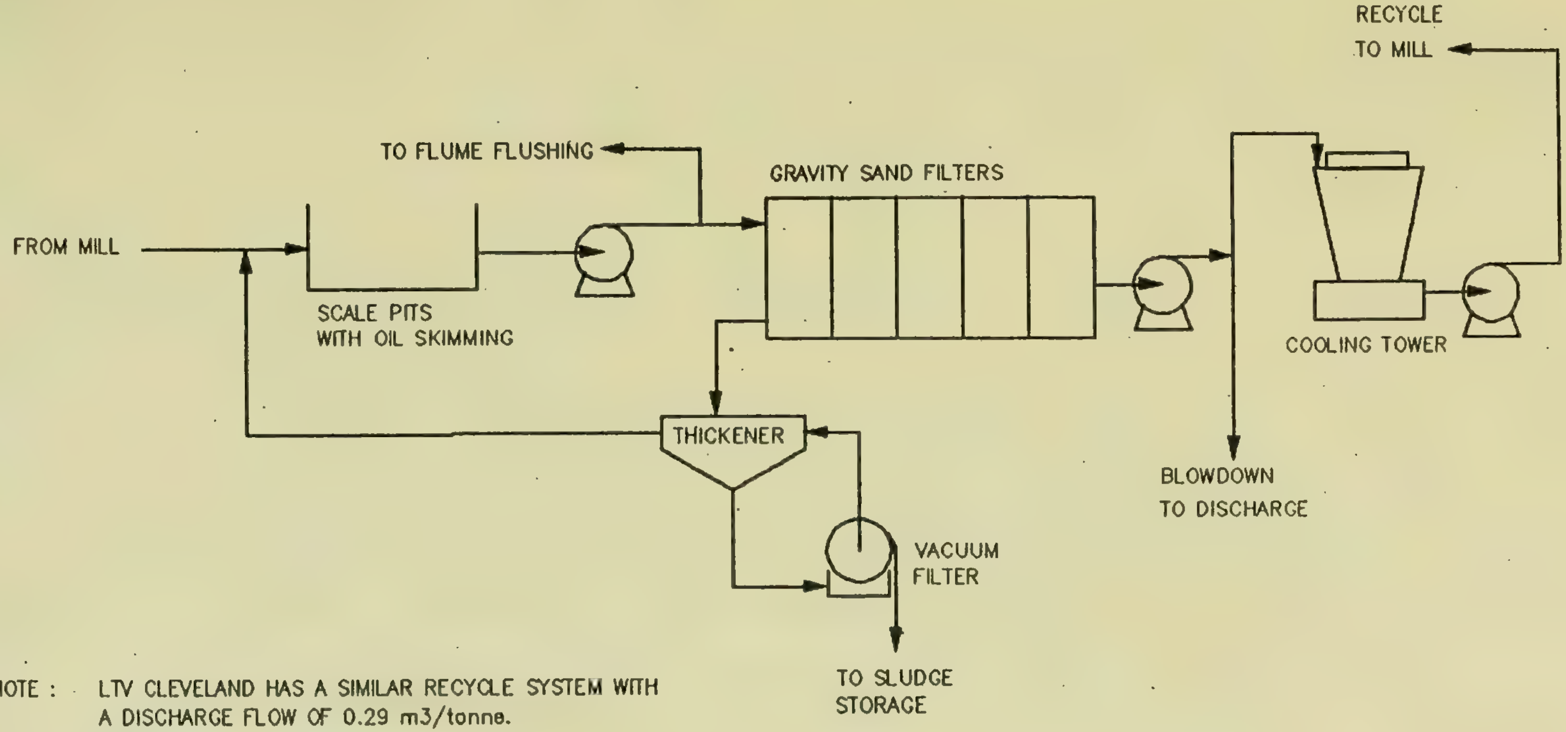
NOTE 3: Compound reported at < RMDL in final effluent (MISA Point 0400).

STELCO STEEL, LAKE ERIE WORKS	TABLE 5.7.2	REV. #2	HATCH ASSOCIATES	1991-09-20

FILES: HFBAT1.WK1 and HFBAT1.ALL

HOT FORMING - MODEL - BAT #2 - BEST IN UNITED STATES

HOT FORMING INCLUDES :
- PRIMARY MILLS
- SECTION MILLS (ROD, BAR, BILLET, ETC)
- FLAT MILLS (PLATE, HOT STRIP)
- PIPE AND TUBE MILLS



NOTE : LTV CLEVELAND HAS A SIMILAR RECYCLE SYSTEM WITH A DISCHARGE FLOW OF 0.29 m3/tonne.

PROCESS FLOW	DISCHARGE FLOW	RECYCLE RATE
35 m3/tonne	0.36 m3/tonne	99 %

US STEEL GARY, INDIANA 84" HOT STRIP MILL | HATCH ASSOCIATES | 1992-02-20 | REV. 2

FIGURE 5.7.2

HOT FORMING: INTEGRATED — BAT #2 – BEST IN THE UNITED STATES

EFFLUENT DATA

HOT FORMING PROD'N (tonne/day): 12965

PERIOD: *Aug 1990 – Jan 1991*

PARAMETER	Avg Flow (m3/tonne)	EPA - BPT * Flow (m3/tonne)		Avg Flow (m3/day)	Max Flow (m3/day)	Min Flow (m3/day)		# Samples	
Flow	0.36	11		4718	37244	0		132	
PARAMETER	**Avg Load. (g/tonne)**	**EPA - BPT ** Avg. Load (g/tonne)**	**Avg Load. (kg/day)**	**Avg Conc'n (mg/L)**	**Max Conc'n (mg/L)**	**Min Conc'n (mg/L)**	**Lab. Meth. Det. Lim. (mg/L)**	**# Samples**	**# < LMDL**
TSS	1.1	160	14	2.9	9.8	0.93	1.0	132	14
oil	2.3	max 107	30	7.1	64	2.0	2.0	132	12

SOURCE OF DATA: PR58585.14, 84" HOT STRIP MILL

* See EPA Development Document Iron and Steel

** See EPA 40 CFR – Part 420.72 (c)(1) Flat Mills – Hot Strip and Sheet Mills, Carbon

US STEEL, GARY WORKS	TABLE 5.7.3	REV. #2	HATCH ASSOCIATES	1992-02-12

FILES: HFBAT2.WK1 and HFBAT2.ALL

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – HOT FORMING – GENERIC

BAT	BAT #1		BAT #2		BAT #3		BAT #4		BAT #5	
Mill	Stelco LEW (Note 1)		US Steel Gary, Indiana							
Flow (m3/tonne)	0.85		0.36							
Parameter	Average Conc. (mg/L)	Average Loading (g/tonne)	Average Conc. (mg/L)	Average Loading (g/tonne)	Average Conc. (mg/L)	Average Loading (g/tonne)	Average Conc. (mg/L)	Average Loading (g/tonne)	Average Conc. (mg/L)	Average Loading (g/tonne)
TSS (Note 3)	* 4.9	4.2	2.9	1.1						
oil and grease	6.3	5.3	7.1	2.3	See BAT #2.		Note 2		Not applicable.	

Notes: 1. Data calculated by disaggregation of loadings from MISA Monitoring Point 0400, based on Stelco LEW information.

2. There is no specific toxicity data available for this stream. This stream does not discharge directly to the receiving water but is combined with other streams prior to discharge. Based on the results of toxicity testing on the effluent from Algoma's No. 2 Tube Mill, during the MISA Monitoring Period, the effluent is considered very likely to pass the Ontario Toxicity Test. Dofasco's No. 2 Hot Mill effluent passed the Ontario Toxicity Test in an Environment Canada study performed from April 15 - 18, 1991; two out of two tests for Rainbow Trout, two out of two tests for Daphnia Magna and one out of one test for Fathead Minnows.

3. Compound reported at < RMDL in final effluent (Stelco LEW MISA Point 0400).

* less than RMDL

1992–02–12	TABLE 5.7.4	HATCH ASSOCIATES	PEQHFGEN.WK1 PEQHFGEN.ALL	REV. # 4

5.8 Integrated Mills - Finishing

5.8.1 BAT #1 Best in Ontario

The Cold Mill Wastewater Treatment Plant at Dofasco was selected as BAT #1 primarily because it is the only one with available reliable direct effluent measurement, on at least one significant effluent stream. Stelco Hilton appears to have comparable operations and wastewater treatment, but no MISA data is available. The treatment system is shown in Figure 5.8.1 *Finishing Model BAT #1 Best in Ontario*. Sulphuric acid is added to the oily wastewater to lower the pH to 2. This breaks the emulsion and allows the oil to float to the top where it is removed to a neutralization tank and then centrifuged. The oil is used as a coal pile dust suppressant. The water is pumped from the bottom of the vessel to a neutralization tank where it is combined with the alkaline and acidic rinses. The combined wastewater is neutralized with lime and clarified prior to discharge.

The rinse water from the electrolytic tinning lines is de-ionized with cation and anion exchange resins. The cation exchange resin is regenerated with sulphuric acid and the effluent is discharged to the neutralization tanks. The anion resin is regenerated with sodium hydroxide and the chrome containing effluent is concentrated in an evaporator and disposed of off site. The deionized and distilled water are returned to the electrolytic lines for reuse.

The effluent data sheet, Table 5.8.1 for this treatment technology is attached.

The order-of-magnitude capital cost for Model BAT #1 Finishing is $\$31 \times 10^6$. Sufficient data is not available to determine operating costs.

This treatment technology removes oil from the oily wastewater stream. The oil can be used as a fuel or in other applications. The solids removed with this treatment system must be disposed of in a landfill site. In addition to the increased solids, the energy requirement for the finishing wastewater treatment system is increased with the addition of process units.

5.8.2 BAT #2 Best in the United States

The best available finishing wastewater treatment technology available in the United States was determined to be National Steel's Midwest Division in Portage, Indiana. The treatment system

is shown in Figure 5.8.2 *Finishing Model BAT #2 Best in the United States*. The Midwest Division of National Steel is a steel finishing plant for production of cold rolled sheets and coated steels. Oily wastewater is processed in a flow equalization tank and two API oil separators. The partially treated water flows to the wastewater treatment facility. The oil is further separated in a dissolved air flotation unit and processed for use as fuel.

The electrolytic tinning wastewater is pretreated in two clarifiers with lime slurry and cationic polymer to precipitate calcium fluoride. The clarifier underflow is dewatered and disposed of off site while the overflow is directed to the wastewater treatment facility.

Wastewater from the Tin Free Steel (TFS) line is treated with sulphuric acid at a pH of 2 to reduce the hexavalent chromium to trivalent chromium. The wastewater is processed in a equalization tank, mixing tanks and reaction tanks. The wastewater then flows to the wastewater treatment facility.

Demineralized water containing hexavalent chromium from the final chemical treatments and washes on the TFS and tin lines is treated in an ion exchange chromium recovery system. The recovered chromium is recycled to the TFS line plating tank and the backwash is directed to the pretreatment facility for the TFS wastewater.

The pretreated streams described above are combined with other mill wastewater for treatment at the wastewater treatment facility. The combined streams are equalized in two aerated mix tanks. Sulphuric acid and lime slurry are used to control pH and form metal precipitates. The wastewater is then processed in two flocculation & sedimentation tanks and discharged through a Parshall flume to the receiving water. Recovered sludge is thickened and filtered then sent to a landfill off site.

The effluent data sheet, Table 5.8.2 for this treatment technology is attached.

The order-of-magnitude capital cost for Model BAT #2 Finishing is $\$73 \times 10^6$. Sufficient data is not available to determine operating costs.

The effluent concentrations recorded for TSS and oil and grease are unusually low for effluent from a clarifier, and are more consistent with expected effluent concentrations, after sand filtration. No reason is known for this, but it has been suggested that process wastewater is being diluted with cooling water. Installation of a clarifier will not normally achieve these results.

The non water quality impacts of this system are the same as the BAT #1 impacts described in section 5.8.1.

5.8.3 BAT #3 Best at Selected World Locations

The best available technology was determined to be BAT #2 National Steel, Midwest Division. The treatment technology is outlined in section 5.8.2.

5.8.4 BAT #4 Non-Lethal

The BAT #3 Finishing wastewater treatment technology was determined to be the BAT #2 treatment process. This technology is detailed in section 5.8.2.

There is no specific toxicity data available for the Finishing wastewater stream at National Steel, Midwest Division. However, the zinc, chromium and hexavalent chromium were determined to be below the single contaminant LC50 values. Therefore, the effluent may pass the Ontario Toxicity Test depending on synergistic effects and hardness. The synergistic effects of the several contaminants in the effluent are not known and cannot be predicted. No demonstrated technologies are known to further reduce the concentrations of metal toxics to lower levels than those measured in this wastewater.

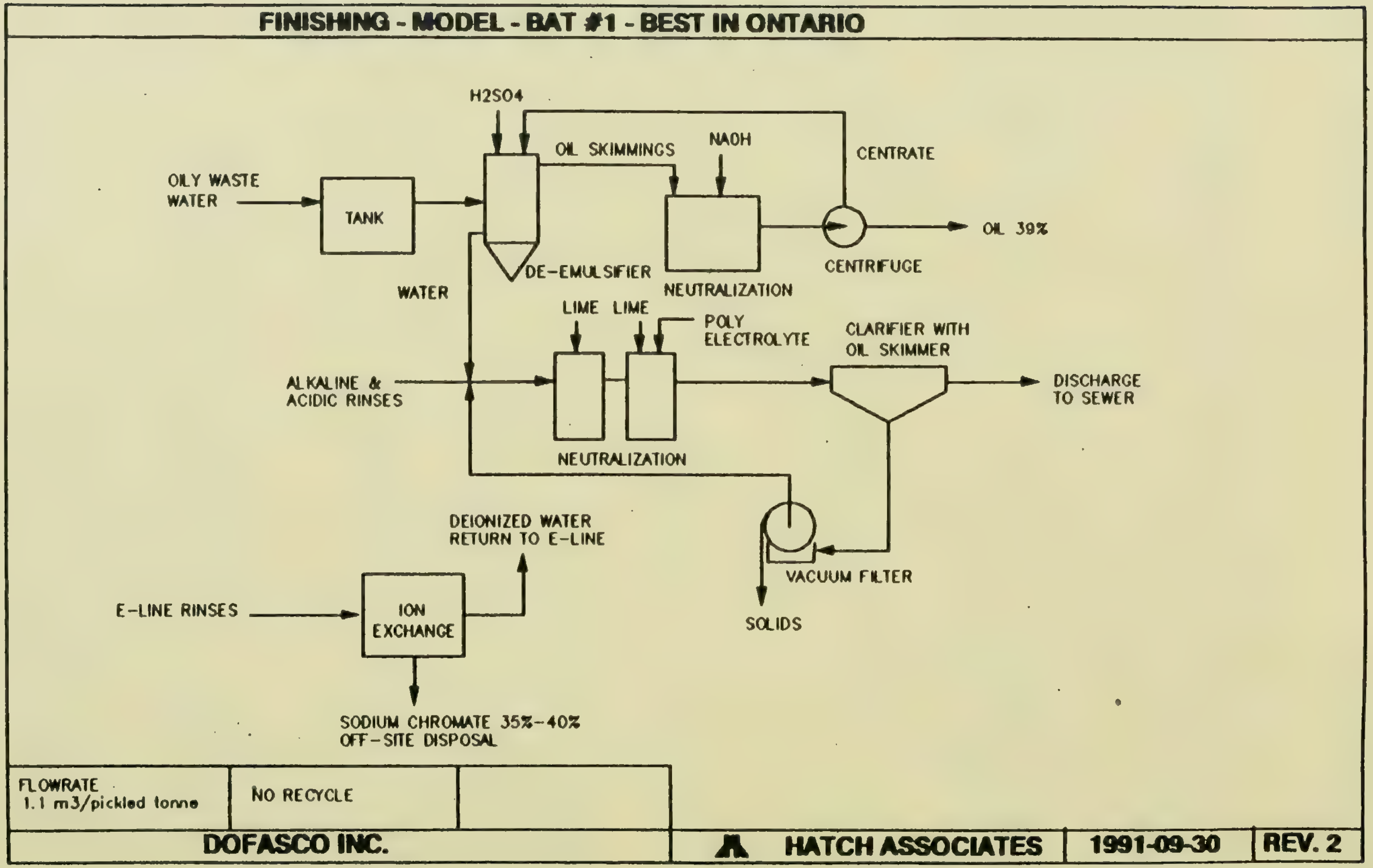
5.8.5 BAT #5 Virtual Elimination of Persistent Toxics

The BAT #3 Finishing wastewater treatment technology was determined to be the BAT #2 treatment process. This technology is detailed in section 5.8.2.

The Finishing wastewater stream is expected to contain low levels of metal toxic contaminants. No demonstrated technologies are known to further reduce the concentrations of these compounds to lower levels those than measured in the wastewater stream. Virtual elimination of persistent toxics can only be assured by zero discharge. This may be achieved with further

treatment by ultrafiltration and ion exchange, or evaporation which may permit the treated water to be recycled to the process. However, these treatment technologies are not demonstrated in this industrial sector.

Table 5.8.3, *Predicted Effluent Quality Integrated Mills - Finishing- Generic*, summarizes the effluent data for each Model BAT option. The flow data and parameter loading data was used to develop the predicted effluent quality for the Applied BAT options for Finishing at Ontario's Integrated Mills (see Volume II).



FINISHING - MODEL - BAT #1 - BEST IN ONTARIO
H2SO4
OIL SKIMMINGS
NAOH
CENTRATE
OILY WASTE WATER
TANK
OIL 39%
DE-EMULSIFIER
NEUTRALIZATION
CENTRIFUGE
WATER
LIME LIME
POLY ELECTROLYTE
CLARIFIER WITH OIL SKIMMER
ALKALINE & ACIDIC RINSES
DISCHARGE TO SEWER
NEUTRALIZATION
DEIONIZED WATER RETURN TO E-LINE
VACUUM FILTER
E-LINE RINSES
ION EXCHANGE
SOLIDS
SODIUM CHROMATE 35%-40% OFF-SITE DISPOSAL
FLOWRATE 1.1 m3/pickled tonne
NO RECYCLE
DOFASCO INC.
HATCH ASSOCIATES
1991-09-30
REV. 2

FIGURE 5.8.1

FINISHING: INTEGRATED — BAT #1 – BEST IN ONTARIO

EFFLUENT DATA

PERIOD: NOV 1989 - OCT 1990

PARAMETER	Avg Flow (m3/tonne)			Avg Flow (m3/day)	Max Flow (m3/day)	Min Flow (m3/day)		# Samples	
Flow	1.1			4875	7287	1514		352	
PARAMETER	**Avg Conc'n (g/tonne)**	**EPA * Avg. Conc. (mg/L)**	**Avg Load. (kg/day)**	**Avg Conc'n (mg/L)**	**Max Conc'n (mg/L)**	**Min Conc'n (mg/L)**	**Reg. Meth. Det. Lim. (mg/L)**	**# Samples**	**# < DL**
TSS	530	30	2298	487	2500	31	5.0	157	0
oil and grease	75	10	326	68	210	2.0	1.0	148	0
lead	0.095	0.15	0.41	0.088	0.59	0.010	0.03	157	46
zinc	0.17	0.2 **	0.74	0.15	2.0	0.010	0.01	157	16
chromium	0.88	0.40	3.8	0.80	0.47	0.010	0.02	157	1
hexavalent chromium	–	0.02	–	–	–	–	–	–	–

SOURCE OF DATA: MISA MONITORING MIDES #1000 COLD MILL WASTEWATER TREATMENT PLANT SEWER (effluent from AP Lines #1,2,3)

NOTE: Calculations based on production at Dofasco's AP Lines # 1,2,3.

* See EPA Development Document Iron and Steel

** Derived from USEPA CFR 40, Part 420 Acid Pickling average loadings for zinc (kg/tonne) and USEPA Development Document Iron and Steel Treatment Model Flows (usgal/ton) for Acid Pickling.

DOFASCO	TABLE 5.8.1	REV. #1	HATCH ASSOCIATES	1992-03-10

FILES: FNBAT1.WK1 and FNBAT1.ALL

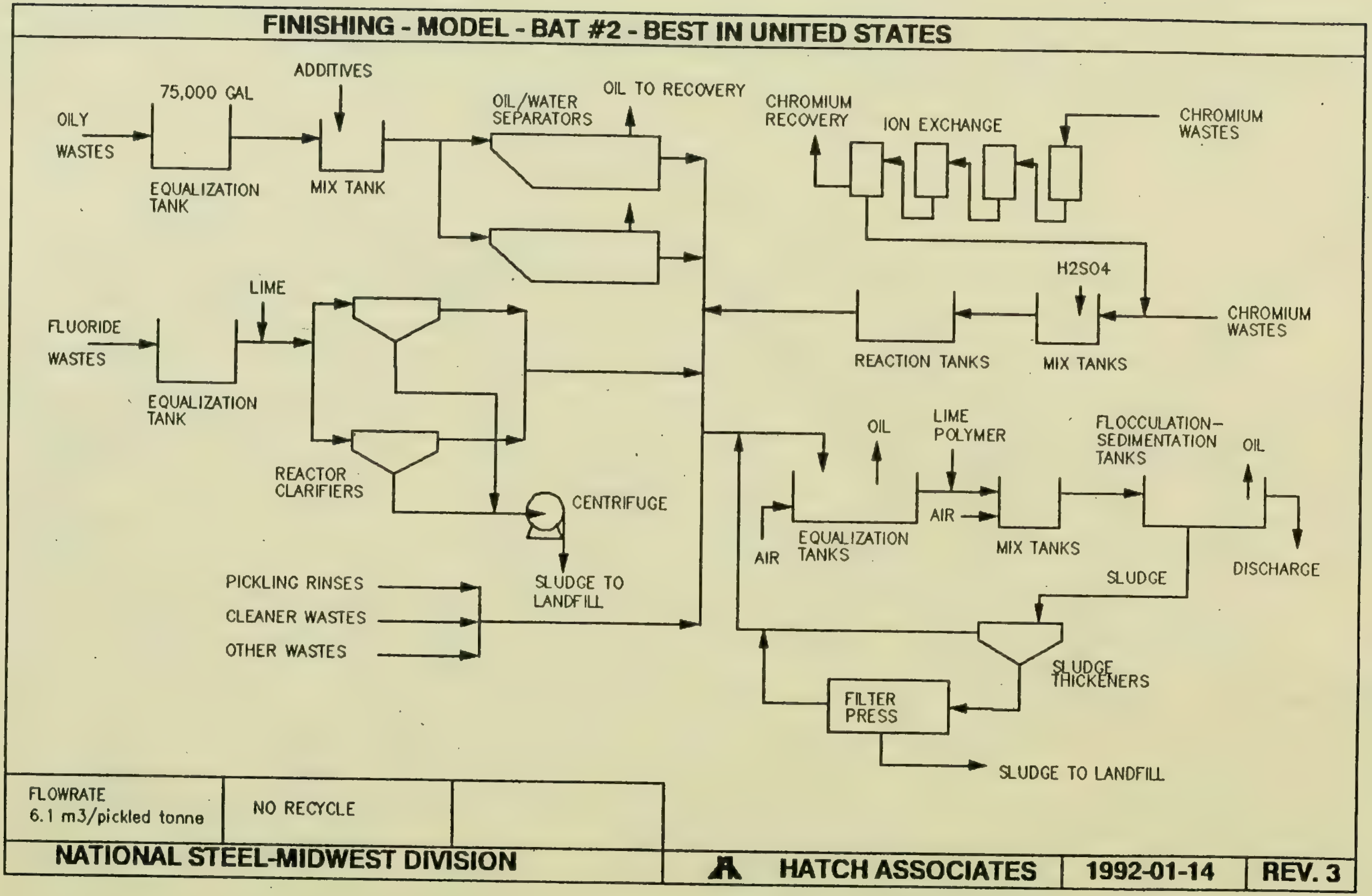

FINISHING - MODEL - BAT #2 - BEST IN UNITED STATES
OILY WASTES
75,000 GAL
EQUALIZATION TANK
ADDITIVES
MIX TANK
OIL/WATER SEPARATORS
OIL TO RECOVERY
CHROMIUM RECOVERY
ION EXCHANGE
CHROMIUM WASTES
FLUORIDE WASTES
LIME
EQUALIZATION TANK
REACTOR CLARIFIERS
CENTRIFUGE
SLUDGE TO LANDFILL
H2SO4
CHROMIUM WASTES
REACTION TANKS
MIX TANKS
OIL
LIME POLYMER
FLOCCULATION-SEDIMENTATION TANKS
OIL
AIR
EQUALIZATION TANKS
AIR
MIX TANKS
DISCHARGE
SLUDGE
PICKLING RINSES
CLEANER WASTES
OTHER WASTES
SLUDGE THICKENERS
FILTER PRESS
SLUDGE TO LANDFILL
FLOWRATE
6.1 m3/pickled tonne
NO RECYCLE
NATIONAL STEEL-MIDWEST DIVISION
HATCH ASSOCIATES
1992-01-14
REV. 3

FIGURE 5.8.2

FINISHING: INTEGRATED				BAT #2 – BEST IN THE UNITED STATES					
ACID PICKLING PROD'N (tonne/day):			3636	EFFLUENT DATA			PERIOD:	MAY 1990 – OCT 1990	
PARAMETER	Avg Flow (m3/tonne)			Avg Flow (m3/day)	Max Flow (m3/day)	Min Flow (m3/day)		# Samples	
Flow	6.1			22038	27290	12869		132	
PARAMETER	Avg Conc'n (g/tonne)	EPA * Avg. Conc. (mg/L)	Avg Load. (kg/day)	Avg Conc'n (mg/L)	Max Conc'n (mg/L)	Min Conc'n (mg/L)	Lab Meth. Det. Lim. (mg/L)	# Samples	# < LMDL
TSS	29	30	107	4.8	33	1.8	1.0	132	0
oil and grease	14	10	51	2.3	12	1.0	1.0	132	7
lead	-	0.15	-	-	-	-	-	-	-
zinc	0.33	0.2 **	1.2	0.054	0.58	0.050	0.05	132	126
chromium	0.31	0.40	1.1	0.051	0.080	0.050	0.05	132	119
hexavalent chromium	0.066	0.02	0.24	0.010	0.010	0.010	0.01	25	25

SOURCE OF DATA: PR#58585.012

* See EPA Development Document Iron and Steel

** Derived from USEPA CFR 40, Part 420 Acid Pickling average loadings for zinc (kg/tonne) and USEPA Development Document Iron and Steel Treatment Model Flows (usgal/ton) for Acid Pickling.

NATIONAL STEEL, MIDWEST	TABLE 5.8.2	REV. #2	HATCH ASSOCIATES	1992-03-10

FILES: FNBAT2.WK1 and FNBAT2.ALL

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – FINISHING – GENERIC (Note 1)

BAT	BAT #1		BAT #2		BAT #3	BAT #4	BAT #5
Mill	Dofasco (Note 2)		National Steel, Midwest				
Flow (m3/tonne)	1.1		6.1				
Parameter	Average Conc. (mg/L)	Average Loading (g/tonne)	Average Conc. (mg/L)	Average Loading (g/tonne)			
TSS	487	530	4.8	29	See BAT #2.	Note 3	No demonstrated technology in this industry sector.
oil and grease	68	75	2.3	14			
lead	0.088	0.095	–	–			
zinc	0.15	0.17	0.054	0.33			
chromium	0.80	0.88	0.051	0.31			
hexavalent chromium	–	–	0.01	0.066			

Notes: 1. The calculations were based on Acid Pickling Production.

2. Data direct from MISA MIDES#1000, COLD MILL WWTP SEWER, production data for APL #1, 2 and 3. This is only part of the total flow from associated with the Main Plant. The total flow, including the flow from the No. 1 ARP is 11 415 m3/day or 2.6 m3/tonne.

3. There is no toxicity data available for National Steel, Midwest, however zinc, chromium and hexavalent chromium are below LC50 levels, and therefore the effluent may pass the Ontario Toxicity Test, depending on synergistic effects. Wastewater technology to further reduce the already low levels of zinc, chromium and hexavalent chromium is not demonstrated.

5.9 Integrated Mills - Excluding Finishing

5.9.1 BAT #1 Best in Ontario

The best integrated wastewater treatment facility in Ontario was determined to be Stelco's Lake Erie Works facility in Nanticoke, Ontario which was commissioned in 1980. The treatment process is shown schematically in Figure 5.9.1 *Integrated Mills Excluding Finishing Model BAT #1 Best in Ontario*. Except for the coke plant, Stelco has relatively high recirculation rates on each process water system and wastewater is cascaded from clean systems for reuse in other dirtier water systems. The wastewater discharged from each process water treatment system is directed to a Blowdown Treatment Plant for final treatment prior to discharge. The wastewater from the cokemaking and ironmaking processes is combined for equalization, metals precipitation, alkaline chlorination, break-point chlorination and filtration at the Blowdown Treatment Plant. The other wastewater streams are combined in a separate treatment system. This treatment consists of equalization, metals precipitation and filtration.

The effluent data sheet, Table 5.9.1 for this treatment technology is attached.

5.9.2 BAT #2 Best in the United States

No directly comparable "sister mill" to Stelco Lake Erie could be identified. Relatively few facilities in the USA have central wastewater treatment plants. The integrated wastewater treatment facility in the United States selected to be BAT #2 was National Steel in Granite City, Illinois. For the purposes of comparison the Granite City effluent data was adjusted to remove the finishing wastewater from the discharge. The treatment process is shown schematically in Figure 5.10.1 *Integrated Mills Including Finishing Model BAT #2 Best in the United States*.

Wastewater from all operations other than the cokemaking and blast furnaces are directed to the Steelworks Lagoon for sedimentation, oil removal with skimmers, and treatment by natural biological processes. The cokeplant wastewater after biological treatment and blast furnace wastewater are combined in the Blast Furnace Lagoon then discharged to the Steelworks Lagoon. Approximately two-thirds of the Steelworks Lagoon effluent is recycled to the Granite City Plant service water distribution system. The balance is filtered and discharged.

National Steel has facilities for chlorination and dechlorination of the filtered effluent. These facilities have not been used for several years since the company has achieved adequate ammonia-N removal without chlorination. The plant's ability to increase the recycle rate is limited by the dissolved solids concentration of the recycled water.

The effluent data sheet, Table 5.10.1, for this treatment technology is attached. The effluent data for the sum of the BAT #2 mills in each of the categories and the effluent data for LTV Steel, Cleveland Works are also shown for information.

5.9.3 BAT #3 Best at Selected World Locations

The best available technology for an integrated mill was determined to be the BAT #1 process based on emissions discharged, at Stelco LEW. The treatment technology is outlined in section 5.9.1.

5.9.4 BAT #4 Non-Lethal

The BAT #3 wastewater treatment technology for Integrated Mills Excluding Finishing was determined to be the BAT #1 treatment process. This treatment technology is outlined in section 5.9.1.

As was outlined in Section 5.9.1 the Blowdown Treatment Plant includes alkaline chlorination and break-point chlorination as part of the treatment process. Alkaline chlorination reacts with cyanide to oxidise the cyanide ultimately to harmless by products. Break-point chlorination breaks down any residual ammonia to nitrogen and chloride ions as chloramines are further oxidized under breakpoint conditions.

Any level of free chlorine remaining is potentially toxic. At Stelco LEW, significant reductions of free chlorine are accomplished in Pond 4. Alternatively SO_2 can be added to the effluent as a dechlorination step. A further potential concern is the formation of THM's through the reaction of chlorine with organics. These compounds are of concern in drinking water supplies.

The current final effluent at Stelco LEW passed the Ontario Toxicity Test ten out of twelve times for Daphnia Magna and twelve out of twelve times for Rainbow Trout during the MISA monitoring period.

Alternatives to chlorination are discussed in Section 6.0.

5.9.5 BAT #5 Virtual Elimination of Persistent Toxics

The BAT #3 wastewater treatment technology for Integrated Mills Excluding Finishing was determined to be the BAT #1 treatment process. This treatment technology is outlined in section 5.9.1.

The MOE definition of BAT #5 is virtual elimination of persistent toxics. If this definition is reviewed for Lake Erie Works, virtual elimination of persistent toxics may have been achieved at LEW MISA point 0400. The uncertainty as to whether virtual elimination has been achieved or not stems from the lack of a precise definition. Almost all contaminants are close to or below the RMDL level, with the exception of cyanide and zinc. However, it is reported that the cyanide is expected to be bound, probably in ferric form and is not toxic in this form. Zinc is below the acute toxic level put forward by the MOE of 66 ug/l, and well below the range established by EPA (FWQC) 45 FR 79318-41 of 180-570 ug/l depending on hardness. Zinc is not a listed persistent bioaccumulative toxic. No demonstrated technologies are known to further reduce the concentrations of these compounds.

Table 5.9.2, *Predicted Effluent Quality - Integrated Mills - Excluding Finishing - Generic*, summarizes the effluent data for each Model BAT option. A comparison of the discharges at Stelco Lake Erie Works during the MISA monitoring period with the RMDL, the LC50 and various Canadian and U.S. regulations is shown in Table 5.9.3 *Stelco LEW Blowdown Treatment Plant Effluent Data*. As a further comparison the discharges at Stelco LEW are compared with the U.S. EPA New Source Performance Standards (NSPS) in Table 5.9.4 *Comparison of Stelco LEW and EPA NSPS Limits*.

Model BAT #1, Stelco LEW, represents an integrated mill with central treatment facilities but no finishing operations. Model BAT #2-A National Steel Granite City, is an integrated mill with

central treatment facilities and finishing operations. The data was adjusted to represent a mill with no finishing operations by subtracting a fraction of the flow and pollutant loadings at National Steel, Midwest proportional to the Finishing production at the two mills, The Finishing operations at National Steel, Granite City and National Steel, Midwest are similar. Model BAT #2-B represents the sum of the flow and pollutant loading data for the Model BAT #2 in all categories. Model BAT #2-C, LTV, Cleveland, represents an integrated mill with no central treatment facilities.

This comparison is presented for information purposes only. Clearly the mills are not directly comparable in terms of production facilities and/or wastewater treatment approaches. The data is presented in an attempt to provide some comparison for the central treatment system at Stelco LEW.

The flow and pollutant loading data was used to develop the predicted effluent quality for the Applied BAT options for the category Integrated Mills - Excluding Finishing for Stelco LEW (see Volume II).

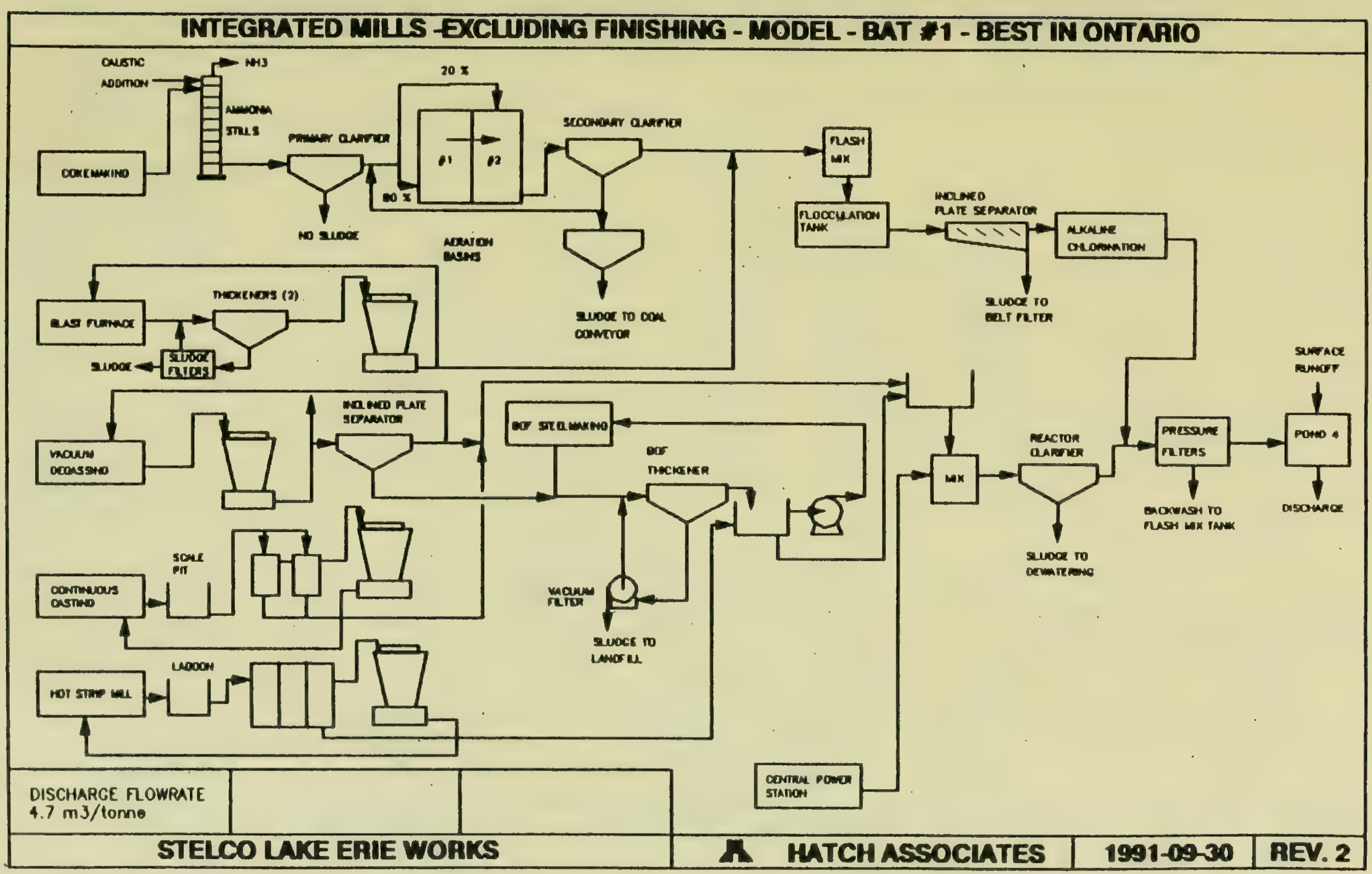

INTEGRATED MILLS -EXCLUDING FINISHING - MODEL - BAT #1 - BEST IN ONTARIO
CAUSTIC ADDITION
NH3
AMMONIA STILLS
COKEMAKING
PRIMARY CLARIFIER
NO SLUDGE
20 %
80 %
#1
#2
AERATION BASINS
SECONDARY CLARIFIER
SLUDGE TO COAL CONVEYOR
FLASH MIX
FLOCCULATION TANK
INCLINED PLATE SEPARATOR
SLUDGE TO BELT FILTER
ALKALINE CHLORINATION
BLAST FURNACE
THICKENERS (2)
SLUDGE FILTERS
SLUDGE
VACUUM DEGASSING
INCLINED PLATE SEPARATOR
BOF STEELMAKING
BOF THICKENER
VACUUM FILTER
SLUDGE TO LANDFILL
MIX
REACTOR CLARIFIER
SLUDGE TO DEWATERING
PRESSURE FILTERS
BACKWASH TO FLASH MIX TANK
SURFACE RUNOFF
POND 4
DISCHARGE
SCALE PIT
CONTINUOUS CASTING
LAGOON
HOT STRIP MILL
CENTRAL POWER STATION
DISCHARGE FLOWRATE
4.7 m3/tonne
STELCO LAKE ERIE WORKS
HATCH ASSOCIATES
1991-09-30
REV. 2

FIGURE 5.9.1

INTEGRATED MILLS		BAT #1 – BEST IN ONTARIO						
		EFFLUENT DATA				PERIOD:	NOV 1989 – JUL 1990	
PARAMETER	Avg Flow (m3/tonne)		Avg Flow (m3/day)	Max Flow (m3/day)	Min Flow (m3/day)		# Samples	
Flow	4.7		19607	23803	4853		105	
PARAMETER	Avg Load. (g/tonne)	Avg Load. (kg/day)	Avg Conc'n (mg/L)	Max Conc'n (mg/L)	Min Conc'n (mg/L)	Reg. Meth. Det. Lim. (mg/L)	# Samples	# < DL
TSS	23	96	* 4.9	10	4.7	5	105	99
oil and grease	6.5	28	1.4	8.0	1.0	1	104	31
ammonia + ammonium	0.39	1.7	* 0.084	0.56	0.025	0.25	105	36
cyanide total	0.53	2.2	0.11	0.28	0.0020	0.005	105	1
phenolics (4AAP)	0.011	0.047	0.0024	0.012	0.0016	0.002	104	44
lead	0.15	0.63	0.031	1.0	0.0060	0.03	103	70
zinc	0.30	1.3	0.063	0.33	0.0090	0.01	103	6
benzene	0.0012	0.0050	* 0.00023	0.0022	0.00020	0.0005	117	114
benzo(a)pyrene	0.0024	0.010	* 0.00050	0.00050	0.00050	0.0006	116	116
naphthalene	0.0014	0.0060	* 0.00030	0.00040	0.00030	0.0016	116	115
chromium	0.044	0.18	* 0.0090	0.067	0.0040	0.02	104	21
hexavalent chromium	–	–	–	–	–	0.01	–	–

SOURCE OF DATA: MISA MONITORING MIDES #0400

NOTE: Stelco, Lake Erie Works does not have Finishing Operations.
* less than RMDL

STELCO STEEL, LAKE ERIE WORKS	TABLE 5.9.1	REV. #2	HATCH ASSOCIATES	1991-09-20

FILES: INBAT1.WK1 and INBAT1.ALL

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – EXCLUDING FINISHING – GENERIC

BAT	BAT #1		BAT #2 – A		BAT #2 – B		BAT #2 – C		BAT #3	BAT #4	BAT #5		
Mill	Stelco LEW		National, Granite		Sum Subcategory		LTV, Cleveland					National, Midwest	
	Central Trtmt (Note 1)		Central Trtmt (Note 2)		No Central Trtmt (Note 3)		No Central Trtmt (Note 3)					Finishing only	
Flow (m3/tonne)	4.7		7.0		0.91		0.72					6.1	
Parameter	Average Conc. (mg/L)	Average Loading (g/tonne)	Average Conc. (mg/L)	Average Loading (g/tonne)	Average Conc. (mg/L)	Average Loading (g/tonne)	Average Conc. (mg/L)	Average Loading (g/tonne)				Average Conc. (mg/L)	Average Loading (g/tonne)
TSS	* 4.9	23	5.7	40	19	17	18	13				4.8	29
oil and grease	1.4	6.5	6.1	42	3.0	2.7	2.5	1.8	See	Note 4	Note 5	2.3	14.1
ammonia + ammonium	* 0.084	0.39	0.85	5.9	18	16	10	7.5	BAT #1.			–	–
cyanide total	0.11	0.53	–	–	1.6	1.5	2.9	2.1				–	–
phenolics (4AAP)	0.0024	0.011	0.0041	0.029	0.033	0.030	0.080	0.057				–	–
lead	0.031	0.15	0.0067	0.047	0.015	0.014	0.016	0.011				–	–
zinc	0.063	0.30	0.042	0.29	0.066	0.060	0.24	0.18				0.054	0.33
benzene	* 0.00023	0.0012	< 0.01	–	0.00066	0.00060	< DL	–				–	–
benzo(a)pyrene	* 0.00050	0.0024	< 0.01	–	0.0048	0.0044	< DL	–				–	–
naphthalene	* 0.00030	0.0014	< 0.01	–	0.0025	0.0023	< DL	–				–	–
chromium	* 0.0090	0.044	–	–	–	–	–	–				0.051	0.31
hexavalent chromium	–	–	–	–	–	–	–	–				0.010	0.066

Notes:
1. Stelco LEW data direct from MISA Point 0400 (no Sintering or Finishing).
2. (Granite Loading – National Loading x Finishing Production Ratio) / Granite Steelmaking Production.
3. Sum of process subcategories excluding Sintering, Vacuum Degassing and Finishing.
4. Stelco LEW current final effluent passed Ontario Toxicity Test ten out of twelve times for Daphnia Magna and twelve out of twelve times for Rainbow Trout during the MISA Monitoring Period.
5. No demonstrated technology in this industry sector but effluent may meet virtual elimination criteria.

* less than RMDL

TABLE 5.9.3: STELCO LEW BLOWDOWN TREATMENT PLANT EFFLUENT DATA

Parameter	MIDES #0400(1) (mg/L)	RMDL(2) (mg/L)	Parameter Selection Status	LC50 (3) (mg/L)	CDN FWQG(4) (mg/L)	PWQO/G(5) (mg/L)	CDN FDWG(6) (mg/L)	ODWO(7) (mg/L)	US EPA FWQC(8) (mg/L)	Comments
TSS	4.9	5	< RMDL	-	up to 10mg/L or Δ 10%	Δ 10% (Secchi)	-	-	-	-
oil and grease	1.4	1	~ RMDL	-	-	-	-	-	-	-
ammonia and ammonium	0.084	0.25	< RMDL	0.16-0.77 un-ionized	0.47 @pH8 & 30C	0.02 un-ionized	-	-	0.47 @pH8 & 30C	Toxicity a function of pH and Temperature
total cyanide	0.11	0.005	> RMDL	0.022	0.005 (free as CN)	0.005 (free as CN)	0.2 (free as CN)	0.2 (free as CN)	0.022 (free as CN)	Combined CN as ferric
phenolics	0.0024	0.002	~ RMDL	5.0-11.6	0.001	0.001	-	0.002	-	To prevent fish tainting
lead	0.031	0.03	~ RMDL	1.47	0.001-0.007	0.005-0.025	0.01	0.05	0.025-0.160	Range prop. to hardness
zinc	0.063	0.01	> RMDL	0.066	0.03	0.03	-	5	0.180-0.570	Range prop. to hardness
benzene	0.00023	0.0005	< RMDL	5.3-21.6	0.3	0.27	0.005	-	-	PWQO 5% of LC50 level
benzo(a)pyrene	0.00050	0.0006	< RMDL	0.006(9)	-	0.0003	0.00001	-	-	PWQO 5% of LC50 level
naphthalene	0.00030	0.0016	< RMDL	-	-	-	-	-	-	-

(1) Data received from the MOE on March 8, 1991 (MIDES = Municipal Industrial Data Entry System).

(2) Regulation Method Detection Limit.

(3) LC50 data from the MOE, draft PWQO/G Development Documents, and MOE Water Resources Branch communication.

(3) Canadian Federal Water Quality Guidelines for Freshwater Aquatic Life, Canadian Council of Resource and Environment Ministers, 1987.

(4) Provincial Water Quality Objectives/Guidelines, Ontario Ministry of the Environment, 1984.

(5) Canadian Federal Drinking Water Guidelines, Canadian Council of Resource and Environment Ministers, 1987.

(6) Ontario Drinking Water Objectives, Ontario Ministry of the Environment, 1983.

(7) U.S. EPA Federal Water Quality Criteria for Freshwater Aquatic Life.

(8) For Fathead Minnow. All other LC50 values are for Rainbow Trout.

Files: LEWBTP.WK1 and LEWBTP.ALL

TABLE 5.9.4: COMPARISON OF STELCO LEW AND EPA NSPS LIMITS(1)

Parameter	Average Loading	
	Stelco LEW(2) (g/tonne)	EPA NSPS(1) (g/tonne)
TSS	23	66
oil and grease	6.5	1.0 – 19 (3)
ammonia and ammonium	0.39	9
total cyanide	0.53	1.7
phenolics	0.011	0.038
lead	0.15	0.20
zinc	0.30	0.30
benzene	0.0012	Max. 0.0128 (4)
benzo(a)pyrene	0.0024	Max. 0.0128 (4)
naphthalene	0.0014	Max. 0.0128 (4)
chromium	0.044	–
hex. chromium	–	–

(1) New Source Performance Standards, summation of EPA 40 CFR - Part 420, Subparts A,C,D,E,F,and G(c-1): Average of daily values for 30 consecutive days. All Cokemaking values have been multiplied by a factor of 0.4, as typically 400 kg of coke are required per raw tonne of steel (used elsewhere in this report). Actual coke/steel ratio at Stelco LEW during MISA monitoring period was 0.38. All Ironmaking values have been multiplied by 0.85 to reflect the amount of iron required per raw tonne of steel at Stelco LEW.

(2) From MISA Monitoring Point 0400.

(3) An average of daily values for 30 consecutive days for Oil and Grease is given for Continuous Casting only, and is 1.0 g/tonne. The maximum for any one day from Cokemaking(*0.4), Ironmaking(*0.85), Continuous Casting, and Hot Forming is 19 g/tonne.

(4) Maximum values for any 1 day, as average values are not published in 40 CFR - Part 420.

Files: LEW_NSPS.WK1 and LEW_NSPS.ALL

5.10 Integrated Mills - Including Finishing

5.10.1 BAT #1 Best in Ontario

The combination of the integrated wastewater treatment system at Stelco Lake Erie Works and the Finishing wastewater treatment system at Dofasco were selected as equivalent to the best integrated treatment system including finishing in Ontario. Stelco's treatment system is described in section 5.9.1 and Dofasco's finishing treatment in described in section 5.8.1.

5.10.2 BAT #2 Best in the United States

Relatively few facilities in the USA have a central wastewater treatment plant. The integrated wastewater treatment facility in the United States selected to be BAT #2 was National Steel in Granite City, Illinois. The treatment process is described in section 5.9.2.

The flow diagram Figure 5.10.1, and effluent data sheet, Table 5.10.1, for this treatment technology are attached.

5.10.3 BAT #3 Best at Selected World Locations

The best available integrated treatment technology was determined to be the process at Stelco Lake Erie Works with the Finishing treatment technology from National Steel, Midwest Division. The treatment technology is outlined in sections 5.9.1 and 5.8.2.

5.10.4 BAT #4 Non-Lethal

The BAT #3 wastewater treatment technology for Integrated Mills Including Finishing was determined to be the BAT #1 treatment process at Stelco LEW with the Finishing technology from National Steel, Midwest Division. This technology is outlined in sections 5.9.1 and 5.8.2.

There is no specific toxicity data available for the BAT #3 wastewater stream. However, based on an assessment of the expected effluent characteristics, specifically the single contaminant LC50 values, the effluent toxicity, as determined by the Ontario Toxicity Test, is probably marginal. All contaminant concentrations in the wastewater stream are below the LC50 levels, except cyanide which is in the bound form and is reported to be non-toxic. The synergistic effects of the several contaminants in the effluent are not known and cannot be predicted.

Toxicity will further depend on hardness and dissolved solids. No demonstrated technologies are known to further reduce the very low levels of contaminants in the wastewater stream.

5.10.5 BAT #5 Virtual Elimination of Persistent Toxics

The BAT #3 wastewater treatment technology for Integrated Mills Including Finishing was determined to be the BAT #1 treatment process at Stelco LEW with the Finishing technology from National Steel, Midwest Division. This technology is outlined in sections 5.9.1 and 5.8.2.

The BAT #3 wastewater stream is expected to contain very low levels of benzo(a)pyrene (persistent bioaccumulative) and other metal and organic toxics. No demonstrated technologies are known to further reduce the concentrations of these toxic contaminants. Virtual elimination of persistent toxics can only be assured by zero discharge. This may be achieved with further treatment by ultrafiltration and ion exchange, or evaporation which may permit the treated water to be recycled to the processes. However, these treatment technologies are not demonstrated in this industrial sector.

Table 5.10.2, *Predicted Effluent Quality - Integrated Mills - Including Finishing - Generic*, summarize the effluent data for each Model BAT option. Model BAT #1 includes data for Stelco LEW's final effluent and data for Dofasco's Finishing effluent. Model BAT #2-A, National Steel, Granite City, represents an integrated mill with central treatment facilities and finishing operations. Model BAT #2-B represents the sum of the Model BAT #2 options for all categories, including National Steel, Midwest for the Finishing component of an integrated mill. Model BAT #3 includes data for Stelco LEW final effluent and data for National Steel, Midwest Finishing effluent.

This comparison is presented for information purposes only. Clearly the mills are not directly comparable in terms of production facilities and/or wastewater treatment approaches. The data is presented in an attempt to provide some comparison for the central treatment systems at Stelco Hilton and Algoma. Dofasco does not utilise a central wastewater treatment plant approach, and is more comparable to BAT #2B.

The flow and pollutant loading data was used to develop the predicted effluent quality for the Applied BAT options for the Category Integrated Mills - Including Finishing for Algoma, Dofasco and Stelco Hilton (see Volume II).

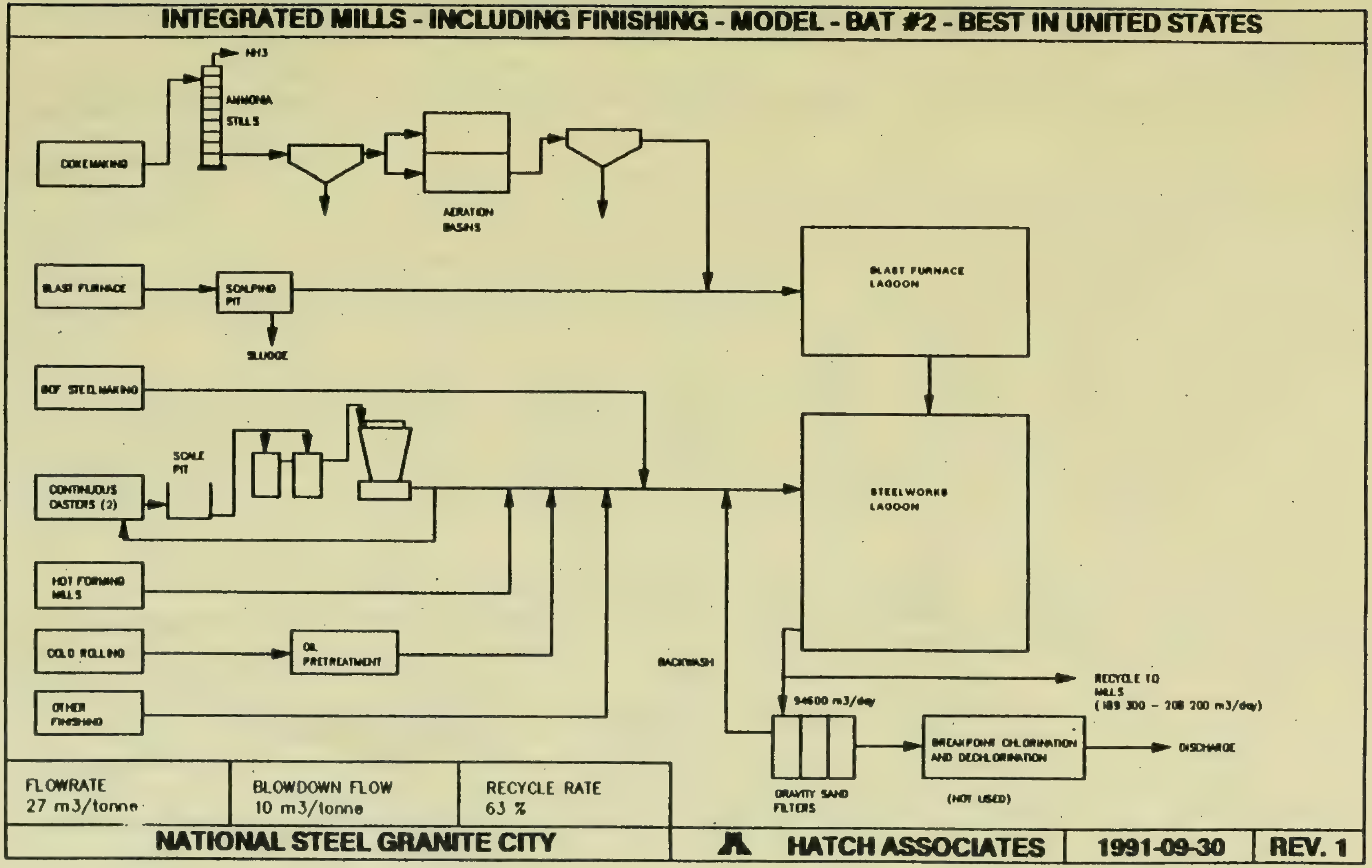

INTEGRATED MILLS - INCLUDING FINISHING - MODEL - BAT #2 - BEST IN UNITED STATES
NH3
AMMONIA STILLS
COKEMAKING
AERATION BASINS
BLAST FURNACE
SCALPING PIT
SLUDGE
BLAST FURNACE LAGOON
BOF STEELMAKING
SCALE PIT
CONTINUOUS CASTERS (2)
STEELWORKS LAGOON
HOT FORMING MILLS
COLD ROLLING
OIL PRETREATMENT
BACKWASH
OTHER FINISHING
RECYCLE TO MILLS
(189 300 - 208 200 m3/day)
94600 m3/day
BREAKPOINT CHLORINATION AND DECHLORINATION
DISCHARGE
GRAVITY SAND FILTERS
(NOT USED)
FLOWRATE
27 m3/tonne
BLOWDOWN FLOW
10 m3/tonne
RECYCLE RATE
63 %
NATIONAL STEEL GRANITE CITY
HATCH ASSOCIATES
1991-09-30
REV. 1

FIGURE 5.10.1

INTEGRATED MILLS			BAT #2 – BEST IN THE UNITED STATES					
STEELMAKING PRODUCTION (tonne/day):		EFFLUENT DATA				PERIOD:	AUG 1990 – JAN 1991	
PARAMETER	Avg Flow (m3/tonne)		Avg Flow (m3/day)	Max Flow (m3/day)	Min Flow (m3/day)		# Samples	
Flow	10		73637	99281	47350		–	
PARAMETER	Avg Load. (kg/tonne)	Avg Load. (kg/day)	Avg Conc'n (mg/L)	Max Conc'n (mg/L)	Min Conc'n (mg/L)	Lab Meth. Det. Lim. (mg/L)	# Samples	# < LMDL
TSS	54	401	5.3	16	4.0	–	–	–
oil and grease	49	364	5.0	5.0	5.0	5.0	–	–
ammonia + ammonium	5.9	44	0.58	3.5	0.10	–	–	–
cyanide total	0.034	0.25	0.0030	0.025	0.0010	0.001	–	–
phenolics (4AAP)	0.029	0.21	0.0030	0.027	0.0010	0.001	–	–
lead	0.047	0.35	0.0050	0.0050	0.0050	0.005	–	–
zinc	0.45	3.3	0.044	0.20	0.020	0.02	–	–
benzene	–	–	< 0.01	–	–	0.01	–	–
benzo(a)pyrene	–	–	< 0.01	–	–	0.01	–	–
naphthalene	–	–	< 0.01	–	–	0.01	–	–
chromium	–	–		–	–	–	–	–
hexavalent chromium	–	–		–	–	–	–	–

SOURCE OF DATA: PR#58585.026

NOTE: National Steel, Granite City has Finishing Operations (Acid Pickling Production = 3628 tonne/day).

NATIONAL STEEL, GRANITE CITY	TABLE 5.10.1	REV. #1	HATCH ASSOCIATES	1991-09-20

FILES: INBAT2A.WK1 and INBAT2A.ALL

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – INCLUDING FINISHING – GENERIC

BAT	BAT #1				BAT #2A		BAT #2B				BAT #3				BAT #4	BAT #5
Mill	Stelco LEW (Note 1)		Dofasco (Note 2)		National, Granite		Sum Sub. (Note 3)		National, Midwest		LEW		National, Midwest			
	Cntrl Trtmnt No Finishing		Finishing only.		Cntrl Trtmnt		No Cntrl Trtmt No Finishing		Finishing only		Cntrl Trtmt No Finishing		Finishing only			
Flow (m3/tonne)	4.7		1.1		10		0.91		6.1		4.7		6.1			
Parameter	Average Conc. (mg/L)	Average Loading (g/tonne)	Average Conc. (mg/L)	Average Loading (g/tonne)	Average Conc. (mg/L)	Average Loading (g/tonne)	Average Conc. (mg/L)	Average Loading (g/tonne)	Average Conc. (mg/L)	Average Loading (g/tonne)	Average Conc. (mg/L)	Average Loading (g/tonne)	Average Conc. (mg/L)	Average Loading (g/tonne)		
TSS	* 4.9	23	487	530	5.4	54	19	17	4.8	29	* 4.9	23	4.8	29		
oil and grease	1.4	6.5	68	75	4.9	49	3.0	2.7	2.3	14.1	1.4	6.5	2.3	14.1	See BAT #3	Note 5
ammonia + ammonium	* 0.084	0.39	–	–	0.60	5.9	18	16	–	–	* 0.084	0.39	–	–	(Note 4).	
cyanide total	0.11	0.53	–	–	0.0034	0.034	1.6	1.5	0.031	0.187	0.11	0.53	–	–		
phenolics (4AAP)	0.0024	0.011	–	–	0.0029	0.029	0.033	0.030	–	–	0.0024	0.011	–	–		
lead	0.031	0.15	0.088	0.095	0.0047	0.047	0.015	0.014	–	–	0.031	0.15	–	–		
zinc	0.063	0.30	0.15	0.17	0.045	0.45	0.066	0.060	0.054	0.33	0.063	0.30	0.054	0.33		
benzene	* 0.00023	0.0012	–	–	< 0.01	–	0.00066	0.00060	–	–	* 0.00023	0.0012	–	–		
benzo(a)pyrene	* 0.00050	0.0024	–	–	< 0.01	–	0.0048	0.0044	–	–	* 0.00050	0.0024	–	–		
naphthalene	* 0.00030	0.0014	–	–	< 0.01	–	0.0025	0.0023	–	–	* 0.00030	0.0014	–	–		
chromium	* 0.0090	0.044	0.80	0.88	–	–	–	–	0.051	0.31	* 0.0090	0.044	0.051	0.31		
hexavalent chromium	–	–	–	–	–	–	–	–	0.010	0.066	–	–	0.010	0.066		

Notes:
1. Stelco LEW data direct from MISA Point 0400.
2. Dofasco data direct from MISA Point 1000. Calculations are based on Acid Pickling production.
3. Sum of process subcategories excluding Sintering and Vacuum Degassing.
4. There is no specific toxicity data for this stream. However, all contaminant concentrations are below LC50 levels (except cyanide which is in bound form and reported as not toxic). Therefore, the effluent is marginal to pass the Ontario Toxicity Text depending on synergistic effects. Wastewater technologies to further reduce these very low levels are not demonstrated.
5. No demonstrated technology in this industry sector.

* less than RMDL

5.11 Integrated Mills - Utilities Best Management Practices

The best management practices for utility wastewater was determined to be at Stelco's Lake Erie Works facility in Nanticoke, Ontario. This treatment system is shown in Figure 5.11.1, *Utilities Model BAT #1 Best in Ontario*. Raw water for the plant's steam supply is treated with lime in a sedimentation tank then filtered and softened in zeolite softeners before being sent to the boilers. The sludge from the sedimentation tank and the backwash from the zeolite softeners is directed to a dirty water sump then pumped to the Blowdown Treatment Plant for treatment. The boiler blowdown is directed to the hot sump then pumped to the Blowdown Treatment Plant.

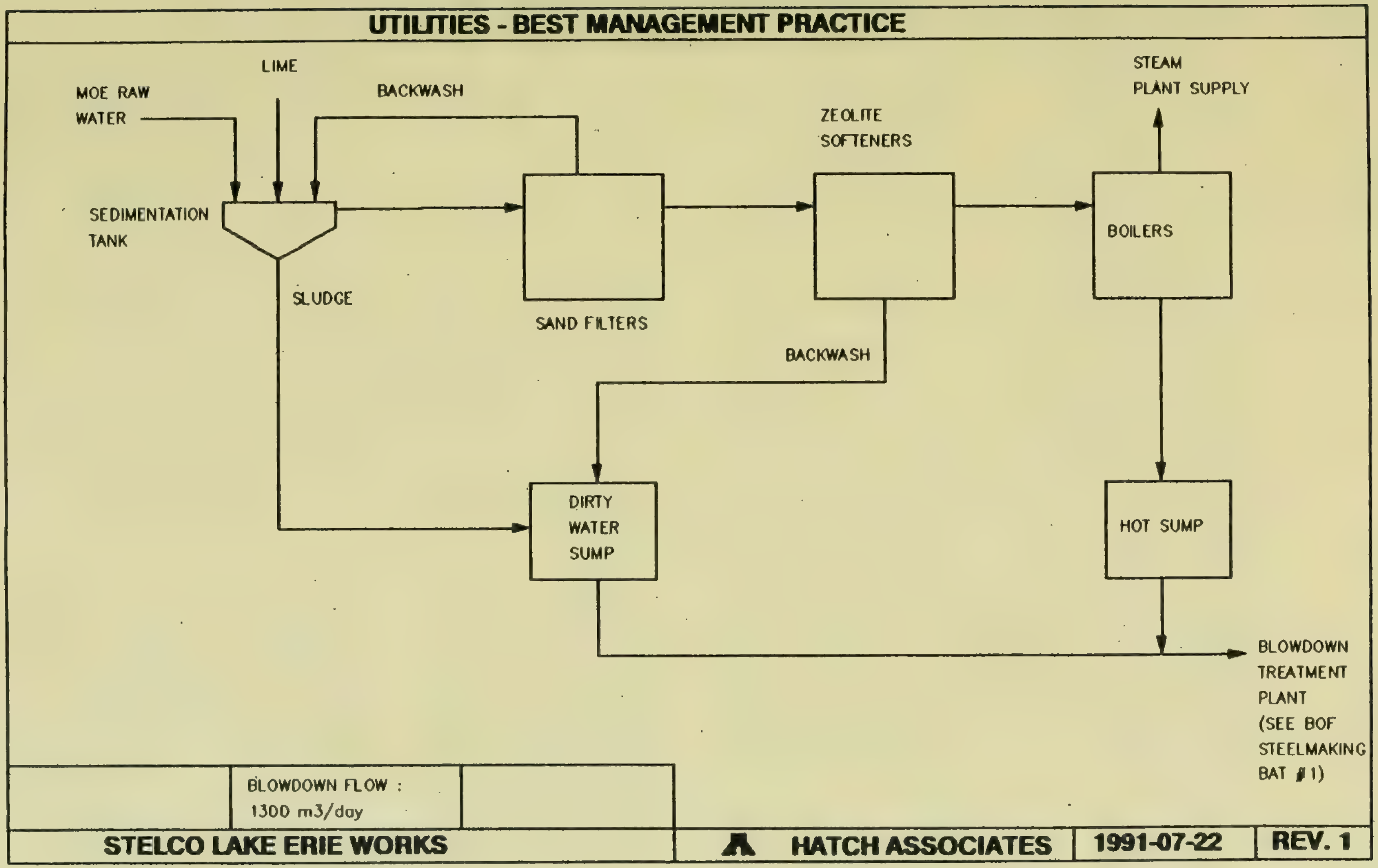

UTILITIES - BEST MANAGEMENT PRACTICE
MOE RAW WATER
LIME
BACKWASH
SEDIMENTATION TANK
SLUDGE
SAND FILTERS
ZEOLITE SOFTENERS
BACKWASH
BOILERS
STEAM PLANT SUPPLY
DIRTY WATER SUMP
HOT SUMP
BLOWDOWN TREATMENT PLANT (SEE BOF STEELMAKING BAT #1)
BLOWDOWN FLOW : 1300 m3/day
STELCO LAKE ERIE WORKS
HATCH ASSOCIATES
1991-07-22
REV. 1

FIGURE 5.11.1

5.12 Integrated Mills - Non-Contact Cooling Water Best Management Practices

The best management practices for non-contact cooling water treatment system in Ontario was determined to be at Stelco's Lake Erie Works facility. The non-contact cooling water is recycled on a process specific basis at the facility. The blowdown streams from each system are directed to the associated process water treatment systems for recycle and treatment. This treatment system is shown in Figure 5.12.1.

The best management practices for non-contact cooling water treatment systems in the United States recycle the water on a process specific basis and use best management practices for the coke plant and blast furnace non-contact cooling water. Non-contact cooling water should be monitored for contaminants. If contaminants are present, an immediate program to locate and remedy the cross contamination should be implemented. If the contaminant problem persists this will result in the stream being reclassified as contact water.

Current practice at Stelco Hilton, Dofasco and Algoma being older mills with facilities up to 90 years old only separates non contact cooling water in the more modern parts of the plant. Combining non contact with contact water in a common collection system results in dilution of process wastewaters which results in larger flows to be treated and lower concentrations of contaminants in the wastewater. This results in both capital and operating costs for wastewaters being much higher than for modern facilities with separate systems.

Unfortunately since there is frequently only one system of supply and/or collection of wastewater, the costs of separation of non contact from contact waters commonly require major retrofit expenditures on duplicate collection and/or supply systems to production mills within an integrated facility, as well as complex retrofitting of distribution and collection piping within the production facility. Separation is required before any recycling can be implemented - for example at the hot forming mills. At Lasco and Algoma cascading of non contact cooling water into contact cooling water is practised. This has the disadvantage that opportunities for recycle are severely limited.

No general cost estimates are available for the separation of systems at existing mills by retrofit. However, an indication of representative costs may be derived from the estimated cost of $74.5 million to implement recycle at Stelco Hilton Central hot forming mills. The work required includes separation of contact (recycled water) and non contact water on the supply side, as well as recycle sumps pumps and cooling towers.

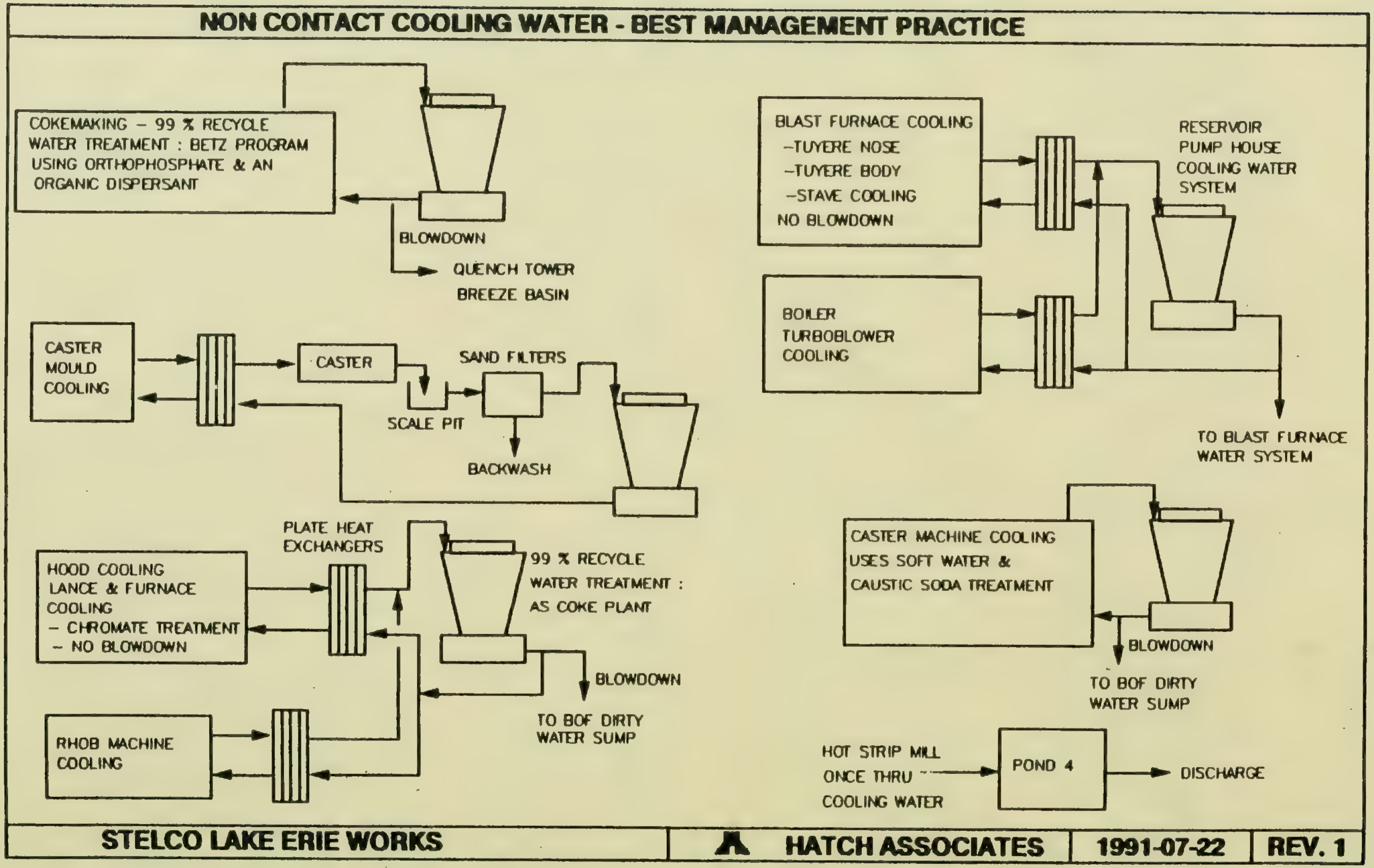

NON CONTACT COOLING WATER - BEST MANAGEMENT PRACTICE
COKEMAKING – 99 % RECYCLE
WATER TREATMENT : BETZ PROGRAM
USING ORTHOPHOSPHATE & AN
ORGANIC DISPERSANT
BLOWDOWN
QUENCH TOWER
BREEZE BASIN
CASTER
MOULD
COOLING
CASTER
SAND FILTERS
SCALE PIT
BACKWASH
PLATE HEAT
EXCHANGERS
HOOD COOLING
LANCE & FURNACE
COOLING
– CHROMATE TREATMENT
– NO BLOWDOWN
99 % RECYCLE
WATER TREATMENT :
AS COKE PLANT
BLOWDOWN
TO BOF DIRTY
WATER SUMP
RHOB MACHINE
COOLING
BLAST FURNACE COOLING
–TUYERE NOSE
–TUYERE BODY
–STAVE COOLING
NO BLOWDOWN
RESERVOIR
PUMP HOUSE
COOLING WATER
SYSTEM
BOILER
TURBOBLOWER
COOLING
TO BLAST FURNACE
WATER SYSTEM
CASTER MACHINE COOLING
USES SOFT WATER &
CAUSTIC SODA TREATMENT
BLOWDOWN
TO BOF DIRTY
WATER SUMP
HOT STRIP MILL
ONCE THRU
COOLING WATER
POND 4
DISCHARGE
STELCO LAKE ERIE WORKS
HATCH ASSOCIATES
1991-07-22
REV. 1

FIGURE 5.12.1

5.13 Integrated Mills - Stormwater Best Management Practices

The best stormwater management system in Ontario was determined to be Stelco's Lake Erie Works facility. The system is shown in the figure *Storm Water Model BAT #1 Best in Ontario*. Stormwater from the coke area foundation pads is collected and treated at the biological treatment plant. The blast furnace area stormwater is collected and used for slag quenching. The stormwater in the hot strip mill area runs into the Hot Strip Mill Lagoon. The stormwater collected in the other plant areas is discharged via Pond 4 and the stormwater collected from the undeveloped areas is discharged via Pond 1 and Pond 2. This treatment system is shown in Figure 5.13.1.

The best stormwater management systems in the United States collect stormwater from the process area and the raw material storage areas and treat the water with the process water in a central treatment system.

At Algoma and Dofasco, rainfall can become contaminated through contact with equipment or building surfaces, road or yard surfaces where spills or drips have occurred. Rainwater typically will either become run-off into ditches or storm sewers discharging into water courses, or will become groundwater.

At Stelco Hilton some run-off is collected and routed to the East Side Filtration Plant prior to discharge. Additional run-off is routed to finger lagoons equipped with oil booms and skimmers, prior to discharge to Hamilton Harbour.

Best stormwater management practice consists of two elements (1) provision for the collection of run off from areas where contamination of rainwater will occur such as coke plants, ore and coal piles etc. and (2) treatment of collected run off. Treatment normally consists of discharge to a holding pond or retention basin to (a) contain the flows and (b) allow sedimentation of settleable solids to occur. For run off with dissolved contaminants (metals or organics constituents from the coke plant) further treatment may be required. In this case coke plant area stormwater from equipment bases etcetera is collected and sent to the coke plant wastewater treatment plant after detention if necessary to minimize peak hydraulic loading at the plant.

Alternately if soluble metals are present in the run off, treatment by pH increase to precipitate metals might be required.

Retrofit of stormwater management infrastructure to an existing plant would be difficult and expensive. It may be possible to provide some retention of collected run off by utilization of capacity in existing lagoons, if high recycle of process wastewater is implemented. (For example at Algoma the Bar and Strip Lagoon and the Terminal Lagoon may be utilized in the future, if capacity becomes available with recycle of process wastewater). However, in general, land for large stormwater ponds is not available and retrofitting collection systems for run off will be prohibitively expensive.

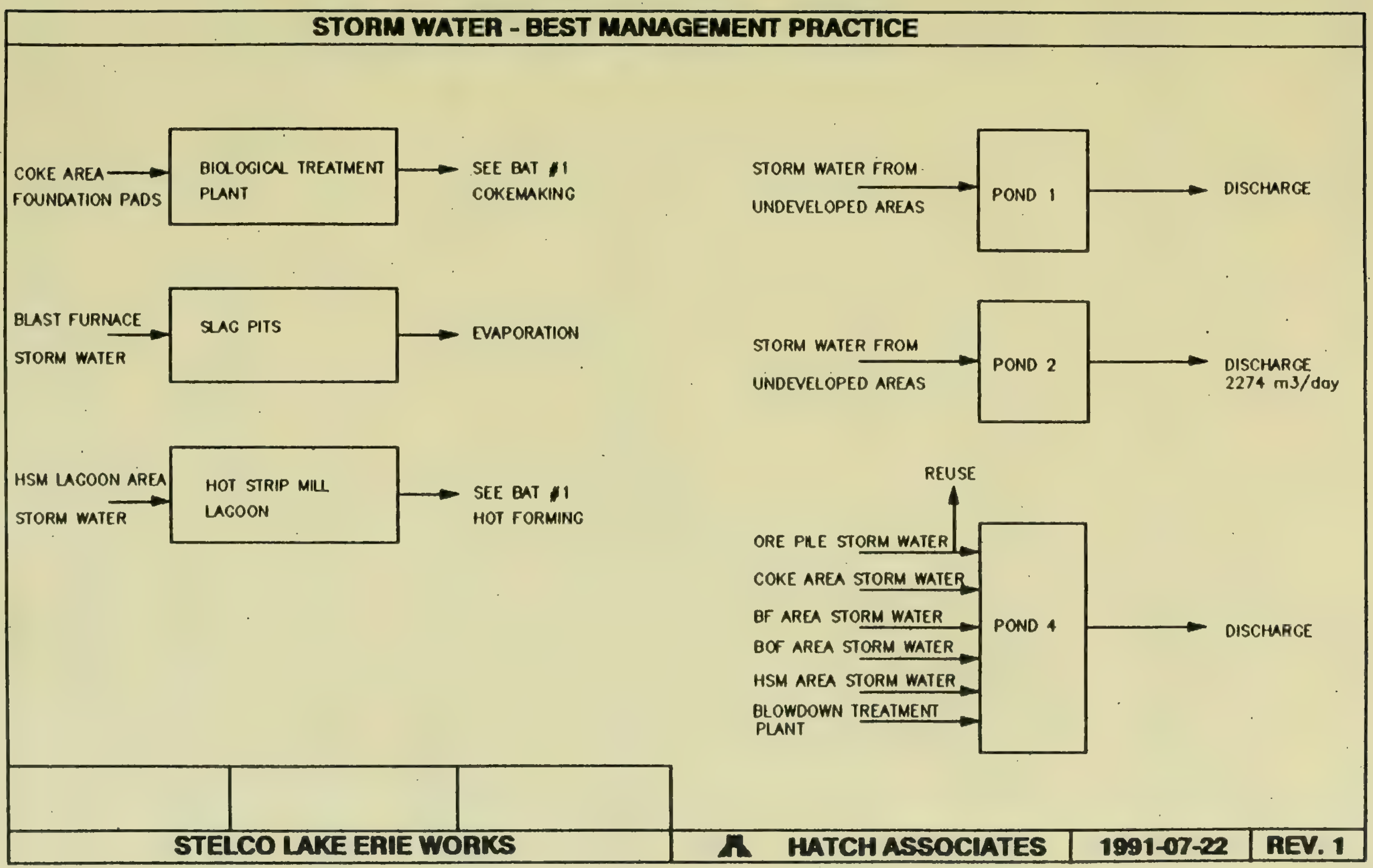

STORM WATER - BEST MANAGEMENT PRACTICE
COKE AREA FOUNDATION PADS
BIOLOGICAL TREATMENT PLANT
SEE BAT #1 COKEMAKING
BLAST FURNACE STORM WATER
SLAG PITS
EVAPORATION
HSM LAGOON AREA STORM WATER
HOT STRIP MILL LAGOON
SEE BAT #1 HOT FORMING
STORM WATER FROM UNDEVELOPED AREAS
POND 1
DISCHARGE
STORM WATER FROM UNDEVELOPED AREAS
POND 2
DISCHARGE 2274 m3/day
REUSE
ORE PILE STORM WATER
COKE AREA STORM WATER
BF AREA STORM WATER
BOF AREA STORM WATER
HSM AREA STORM WATER
BLOWDOWN TREATMENT PLANT
POND 4
DISCHARGE
STELCO LAKE ERIE WORKS
HATCH ASSOCIATES
1991-07-22
REV. 1

FIGURE 5.13.1

5.14 Specialty Steel Mills

5.14.1 BAT #1 Best in Ontario

Atlas Specialty Steels is the only specialty steel producer in Ontario. Therefore it is not possible to identify a BAT #1 for this category.

5.14.2 BAT #2 Best in the United States

The best Hot Forming wastewater treatment technology in the United States was determined to be US Steel's Gary Works facility. This treatment technology is described in section 5.7.2.

The best Continuous Casting wastewater treatment technology in the United States was determined to be Inland Steel's Indiana Harbour Works facility. This treatment technology is described in section 5.6.2.

The best treatment facility in the United States for specialty mill finishing wastewater was determined to be Mercury Stainless in Massillion, Ohio. At this facility, the spent pickling acids are pretreated by passing them through a limestone bed for partial neutralization. These wastes are combined with the pickling rinsewater. The pH is adjusted to 9.2 with lime prior to settling in two clarifiers. Polymer is added to aid in the settling of metal hydroxides. The cold rolling wastewater is also treated with the acid streams. Settled sludge is dewatered in a plate and frame filter press and disposed of in an off site landfill. The effluent data sheet, Table 5.14.1, for this treatment technology is attached.

The treatment systems outlined above are shown in Figures 5.14.1 and 5.14.2 *Specialty Mill Model BAT #2 Best in the United States*.

The order-of-magnitude capital and operating costs for Model BAT #2 Specialty Mills are $\$43 \times 10^6$ and $\$11 \times 10^6$ respectively.

5.14.3 BAT #3 Best at Selected World Locations

The best treatment process for specialty mill wastewater was determined to be the BAT #2 treatment system. This technology is described in section 5.14.2.

5.14.4 BAT #4 Non-Lethal

The BAT #3 Specialty Steels wastewater treatment technology was determined to be the BAT #2 treatment processes for both the Hot Forming and Finishing wastewaters. This technology is detailed in section 5.14.2.

There is no specific toxicity data available for the Hot Forming and Finishing wastewater streams. However, based on an assessment of the expected effluent characteristics, specifically the single contaminant LC50 values, the toxicity of the combined effluent, as determined by the Ontario Toxicity Test, is probably marginal. The synergistic effects of the several contaminants in the effluent are not known and cannot be predicted. If the future combined effluent fails the Ontario Toxicity Test, the Finishing wastewater may be treated by ultrafiltration and ion exchange, or evaporation which may permit the treated water to be recycled to the processes. However, these treatment technologies are not demonstrated in this industrial sector.

5.14.5 BAT #5 Virtual Elimination of Persistent Toxics

The BAT #3 Specialty Steels wastewater treatment technology was determined to be the BAT #2 treatment processes for both the Hot Forming and Finishing wastewaters. This technology is detailed in section 5.14.2.

Hot forming wastewater streams do not normally contain toxic metals or organics. Virtual elimination of persistent toxics is therefore not a requirement in this case and BAT #5 is not applicable.

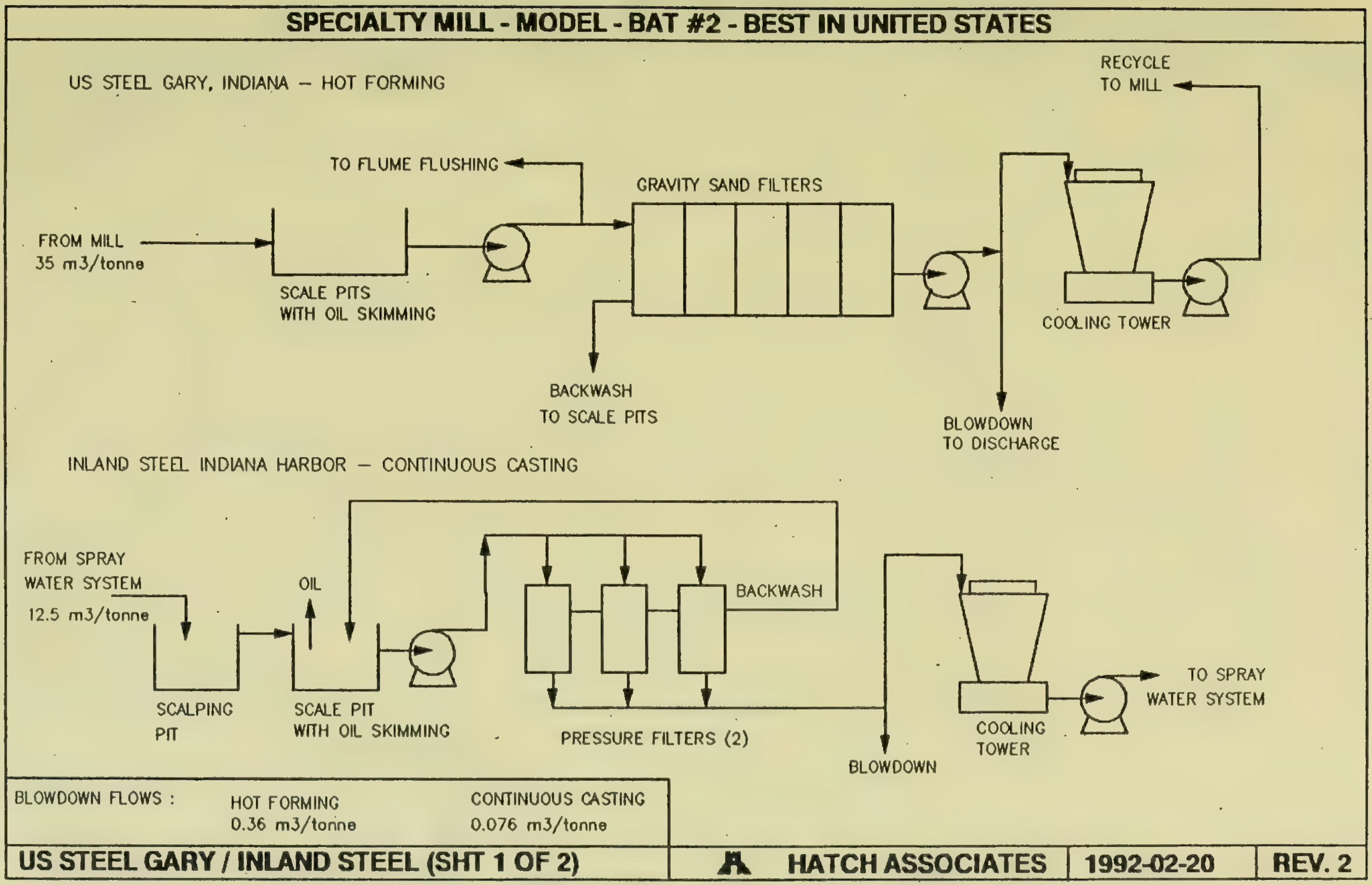
The Finishing wastewater stream is expected to contain very low levels of nickel, which is a persistent bioaccumulative toxic, and other toxic metal contaminants. No demonstrated technologies are known to further reduce the concentrations of these compounds. Virtual elimination of persistent toxics can only be assured by zero discharge. This may be achieved with further treatment by ultrafiltration and ion exchange, or evaporation which may permit the treated water to be recycled to the process. However, these treatment technologies are not demonstrated in this industrial sector.

Table 5.14.2, *Predicted Effluent Quality Specialty Mills - Generic*, summarizes the effluent data for each Model BAT option. The flow and pollutant loading data was used to develop the

predicted effluent quality for the Applied BAT options for Atlas (see Volume II). As a further comparison, the discharges at Atlas during the MISA monitoring period are given with the RMDL, the LC50 and various Canadian and US regulations in Table 5.14.3 *Assessment of Specialty Steel Effluent Data*.

5.14.6 NCCW and Stormwater

Best management practises for Integrated Mills NCCW and stormwater systems are described in Sections 5.12 and 5.13 respectively. These practices also apply to Specialty Mills.



SPECIALTY MILL - MODEL - BAT #2 - BEST IN UNITED STATES
US STEEL GARY, INDIANA – HOT FORMING
RECYCLE TO MILL
TO FLUME FLUSHING
GRAVITY SAND FILTERS
FROM MILL 35 m3/tonne
SCALE PITS WITH OIL SKIMMING
COOLING TOWER
BACKWASH TO SCALE PITS
BLOWDOWN TO DISCHARGE
INLAND STEEL INDIANA HARBOR – CONTINUOUS CASTING
FROM SPRAY WATER SYSTEM 12.5 m3/tonne
OIL
BACKWASH
SCALPING PIT
SCALE PIT WITH OIL SKIMMING
PRESSURE FILTERS (2)
TO SPRAY WATER SYSTEM
COOLING TOWER
BLOWDOWN
BLOWDOWN FLOWS :
HOT FORMING 0.36 m3/tonne
CONTINUOUS CASTING 0.076 m3/tonne
US STEEL GARY / INLAND STEEL (SHT 1 OF 2)
HATCH ASSOCIATES
1992-02-20
REV. 2

FIGURE 5.14.1

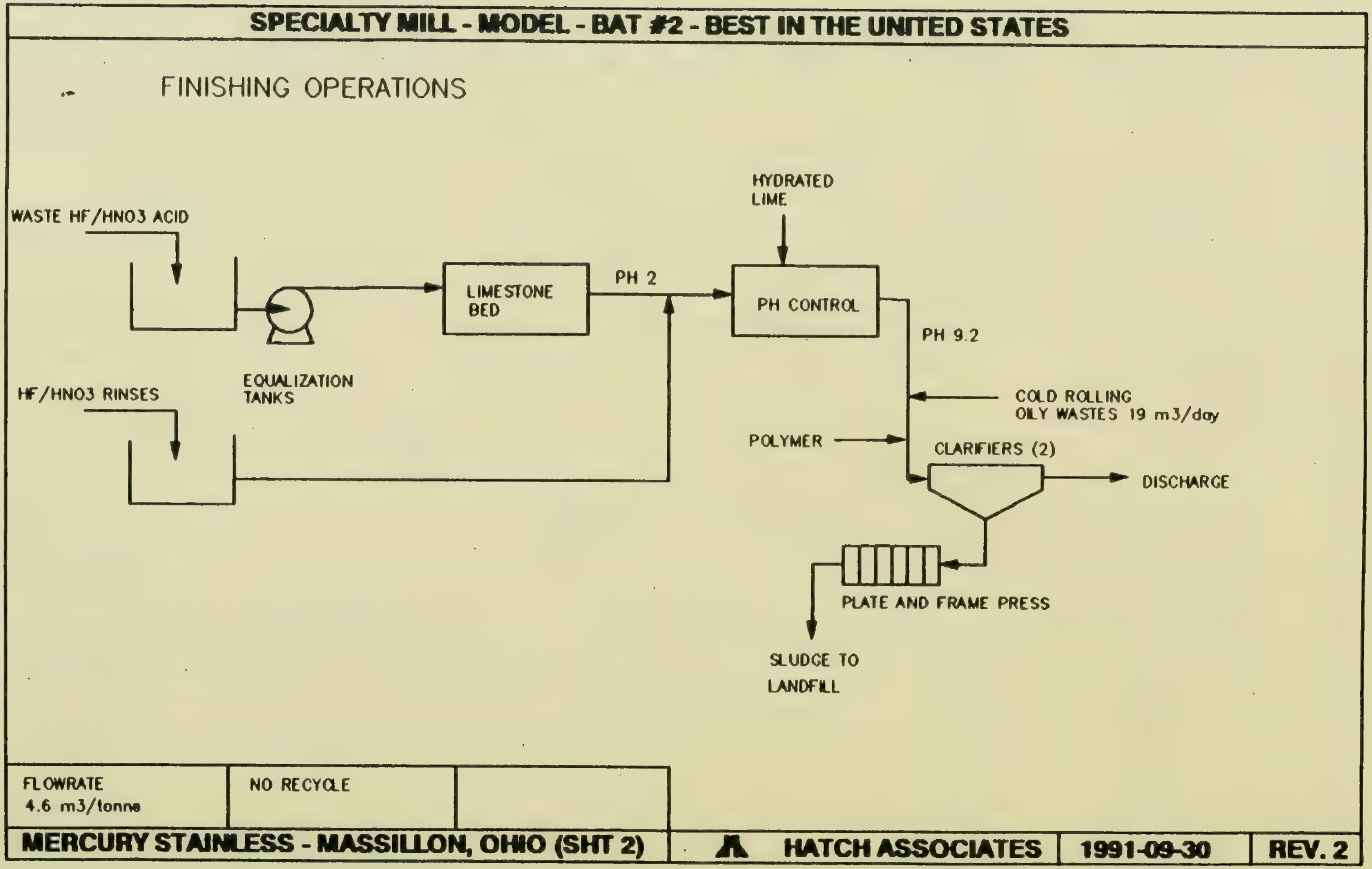

SPECIALTY MILL - MODEL - BAT #2 - BEST IN THE UNITED STATES
FINISHING OPERATIONS
WASTE HF/HNO3 ACID
HF/HNO3 RINSES
EQUALIZATION
TANKS
LIMESTONE
BED
PH 2
HYDRATED
LIME
PH CONTROL
PH 9.2
COLD ROLLING
OILY WASTES 19 m3/day
POLYMER
CLARIFIERS (2)
DISCHARGE
PLATE AND FRAME PRESS
SLUDGE TO
LANDFILL
FLOWRATE
4.6 m3/tonne
NO RECYCLE
MERCURY STAINLESS - MASSILLON, OHIO (SHT 2)
HATCH ASSOCIATES
1991-09-30
REV. 2

FIGURE 5.14.2

SPECIALTY MILL – FINISHING | BAT #2 – BEST IN THE UNITED STATES

FINISHING PRODUCTION (tonne/day): 612

EFFLUENT DATA

PERIOD: JUN 1990 - NOV 1990

PARAMETER	Avg Flow (m3/tonne)			Avg Flow (m3/day)	Max Flow (m3/day)	Min Flow (m3/day)		# Samples	
Flow	4.6			2808	4438	1574		26	
PARAMETER	**Avg Load. (g/tonne)**	**EPA * Avg. Conc. (mg/L)**	**Avg Load. (kg/day)**	**Avg Conc'n (mg/L)**	**Max Conc'n (mg/L)**	**Min Conc'n (mg/L)**	**Lab Meth. Det. Lim. (mg/L)**	**# Samples**	**# < LMDL**
TSS	85	30	52	18	35	2.0	1.0	26	0
oil	4.6	10	2.8	1.0	1.0	1.0	0.10	25	1
lead	0.46	0.15	0.28	0.10	0.26	0.025	-	26	-
zinc	-	0.20 **	-	-	-	-	-	-	-
chromium	0.54	0.4	0.33	0.11	0.33	0.035	-	26	-
hexavalent chromium	0.10	0.02	0.062	0.024	0.065	0.011	-	26	-
cadmium	0.052	no limit	0.032	0.011	0.013	0.0010	-	26	-
nickel	1.0	0.3	0.60	0.21	0.58	0.072	-	26	-

SOURCE OF DATA: PR58585.027

* See EPA Development Document Iron and Steel

** Derived from USEPA CFR 40, Part 420 Acid Pickling average loadings for zinc (kg/tonne) and USEPA Development Document Iron and Steel Treatment Model Flows (usgal/ton) for Acid Pickling.

NOTE: for BAT #2 SPECIALTY MILL - HOT FORMING, CONT. CAST., see BAT #2 HOT FORMING, CONT. CAST.

MERCURY STAINLESS, MASSILLON, OHIO | TABLE 5.14.1 | REV. #2 | HATCH ASSOCIATES | 1992-03-10

FILES: SPBAT2.WK1 and SPBAT2.ALL

PREDICTED EFFLUENT QUALITY

SPECIALTY MILLS – GENERIC

BAT	BAT #1	BAT #2 – A		BAT #2 – B		BAT #3	BAT #4	BAT #5
Mill		MERCURY, OHIO		US Gary/Inland I.H.				
		Finishing		Excluding Finishing				
				(Note 1)				
Flow (m3/tonne)		4.6		0.44				
Parameter		Average Conc. (mg/L)	Average Loading (g/tonne)	Average Conc. (mg/L)	Average Loading (g/tonne)			
TSS	Not applicable.	18	85	5.7	2.5	See BAT #2.	Note 2	Note 3
oil and grease		1.0	4.6	5.7	2.5			
lead		0.10	0.46	0.020	0.0087			
zinc		–	–	0.018	0.0080			
chromium		0.11	0.54	–	–			
hexavalent chromium		0.024	0.10	–	–			
cadmium		0.011	0.052	–	–			
nickel		0.21	1.0	–	–			

Notes:
1. The data for BAT #2 - B (Excluding Finishing) is the sum of BAT #2 Hot Forming and BAT #2 Continuous Casting.
2. Combined Finishing and Hot Mill wastewater probably marginal for passing the Ontario Toxicity Test. Finishing wastewaters may require additional treatment by ultrafiltration/ion exchange or evaporation, and recycle of treated wastewater to process. These technologies are not demonstrated in this industry sector.
3. Hot Forming wastewater normally does not contain persistent toxics, so virtual elimination is not applicable. Lead is predicted <RMDL, zinc is predicted at <PWQO. Finishing wastewater will contain very low levels of nickel and other metals. Additional treatment by ultrafiltration/ion exchange or evaporation, and then recycle of treated wastewater to the process will achieve no point source discharge. However, these treatment technologies are not demonstrated in this industry sector.

TABLE 5.14.3: ASSESSMENT OF SPECIALTY STEEL EFFLUENT DATA

PARAMETER	Atlas Existing (5) (mg/L)	BAT #2 APPLIED (mg/L)	PWQO/G BLUE BOOK (1) (mg/L)	ACUTE LC50 (2) (mg/L)	RMDL (3) (mg/L)	ASSESSMENT EXISTING + BAT #1		ASSESSMENT BAT #2 APPLIED	
						Toxicity(4)	Elimination	Toxicity(4)	Elimination
TSS	6.2	10	∆ 10% (Secchi)	n/a	5	–	>RMDL	–	>RMDL
oil and grease	2.8	4.2	n/a	n/a	1	–	>RMDL	–	>RMDL
lead	0.017	0.045	0.005–0.025	1.47	0.03	NL	>PWQO <RMDL	NL	>PWQO >RMDL
zinc	0.053	0.012	0.030	0.066	0.01	NL	>PWQO >RMDL	NL	<PWQO >RMDL
chromium	0.020	0.037	0.10	3.4	0.02	NL	<PWQO =RMDL	NL	<PWQO >RMDL
hex. chromium	0.0050	0.0069	0.17	3.4 – 65.5	0.01	NL	<PWQO <RMDL	NL	<PWQO <RMDL
cadmium	0.00020	0.0036	0.0002	0.0039	0.002	NL	=PWQO <RMDL	~L	>PWQO >RMDL
nickel	0.16	0.069	0.025	2.5	0.02	NL	>PWQO >RMDL	NL	>PWQO >RMDL

(1) Provincial Water Quality Objectives/Guidelines, Ontario Ministry of the Environment, 1984.
(2) For Rainbow Trout. Obtained from the MOE, draft PWQO/G Development Documents, and MOE Water Resources Branch communication.
(3) Regulation Method Detection Limit.
(4) NL denotes non-lethal.
(5) Atlas Existing data from MISA Monitoring Point 0100.

Files: Spec.WK1 and Spec.ALL

5.15 Mini-Mills

5.15.1 BAT #1 Best in Ontario

The best wastewater treatment system in Ontario for Mini-Mills was determined to be Ivaco Rolling Mills in L'Orignal, Ontario. However, this system was operated in an experimental mode for some 2½ years. Water used for direct contact cooling of the rolls in the rod mill during the hot forming process flows to a scale pond then to a mill pond for solids removal. The water is sprayed into an open spray pond for cooling then recirculated to the mill.

Billet spray water is used for direct contact cooling of the cast steel billets. The water passes through a scale pit then one of two Adams filters and returned to the casting machine. The backwash from the Adams filters is directed to the mill pond.

There was no wastewater discharged from this system during the MISA Monitoring period. However, Ivaco advise that they cannot maintain no discharge to receiving water at this time, and they intend to discharge an average of 0.26 m^3/tonne to a maximum of 1.00 m^3/tonne. Effluent characteristics are expected to be <10 ppm TSS and <5 ppm oil and grease.

After review at the BAT subcommittee of the Joint Technical Committee, it was resolved that this would be selected as BAT #1. The treatment system for Model BAT #1 Mini Mills is shown in Figure 5.15.1. The effluent data is shown in Table 5.15.1, *Predicted Effluent Quality-Mini Mills-Generic*.

The order-of-magnitude capital and operating costs for Model BAT #1 Mini Mills are \$3 x 10^6 and \$.8 x 10^6 respectively.

5.15.2 BAT #2 Best in the United States

The best available wastewater treatment system for Mini-Mills in the United States was determined to be Nucor in Crawfordsville, Indiana. This system is shown in Figure 5.15.2 *Mini Mills Model BAT #2 Best in the United States*. Water from the hot strip mill and continuous caster flows to a scale pit with oil removal. The water is then pumped over a cooling tower. A small blowdown stream is taken off after the cooling tower. This water is used for slag cooling and electrode direct cooling. The remaining water is softened with lime and returned to the scale

pit. Some of the cooled water is returned to the hot strip mill and the remaining water is filtered and returned to the caster system. There is no wastewater discharged from this system to receiving waters.

Ivaco and Lasco have expressed serious reservations about transferring this technology to their mills.

The order-of-magnitude capital and operating costs for Model BAT #2 Mini Mills are $\$6 \times 10^6$ and $\$1.9 \times 10^6$ respectively.

5.15.3 <u>BAT #3 Best at Selected World Locations</u>

Nucor Crawfordsville, Indiana has no wastewater discharge to receiving waters from their operations. The process is described in section 5.15.2. Nucor successfully recycles 98% of their process water and disposes of the remaining 2% by slag evaporation and direct electrode cooling.

5.15.4 <u>BAT #4 Non-Lethal</u>

Nucor in Crawfordsville, Indiana represents a non-lethal treatment systems since the mill has no wastewater discharge to receiving water from its operations. The process is described in section 5.15.2.

Ivaco blowdown from their new filter system may pass the Ontario Toxicity Test depending on dissolved solids levels.

5.15.5 <u>BAT #5 Virtual Elimination of Persistent Toxics</u>

Nucor in Crawfordsville, Indiana represents a treatment system with virtual elimination of persistent toxics since the mill has no wastewater discharge to receiving water from its operations. The process is described in section 5.15.2.

Ivaco future effluent will have to be assessed for compliance with virtual elimination, but it may well be in compliance.

5.15.6 NCCW and Stormwater

Best management practices for Integrated Mills NCCW and Stormwater systems are described in Sections 5.1.2 and 5.1.3 respectively. These practices also apply to Mini Mills.

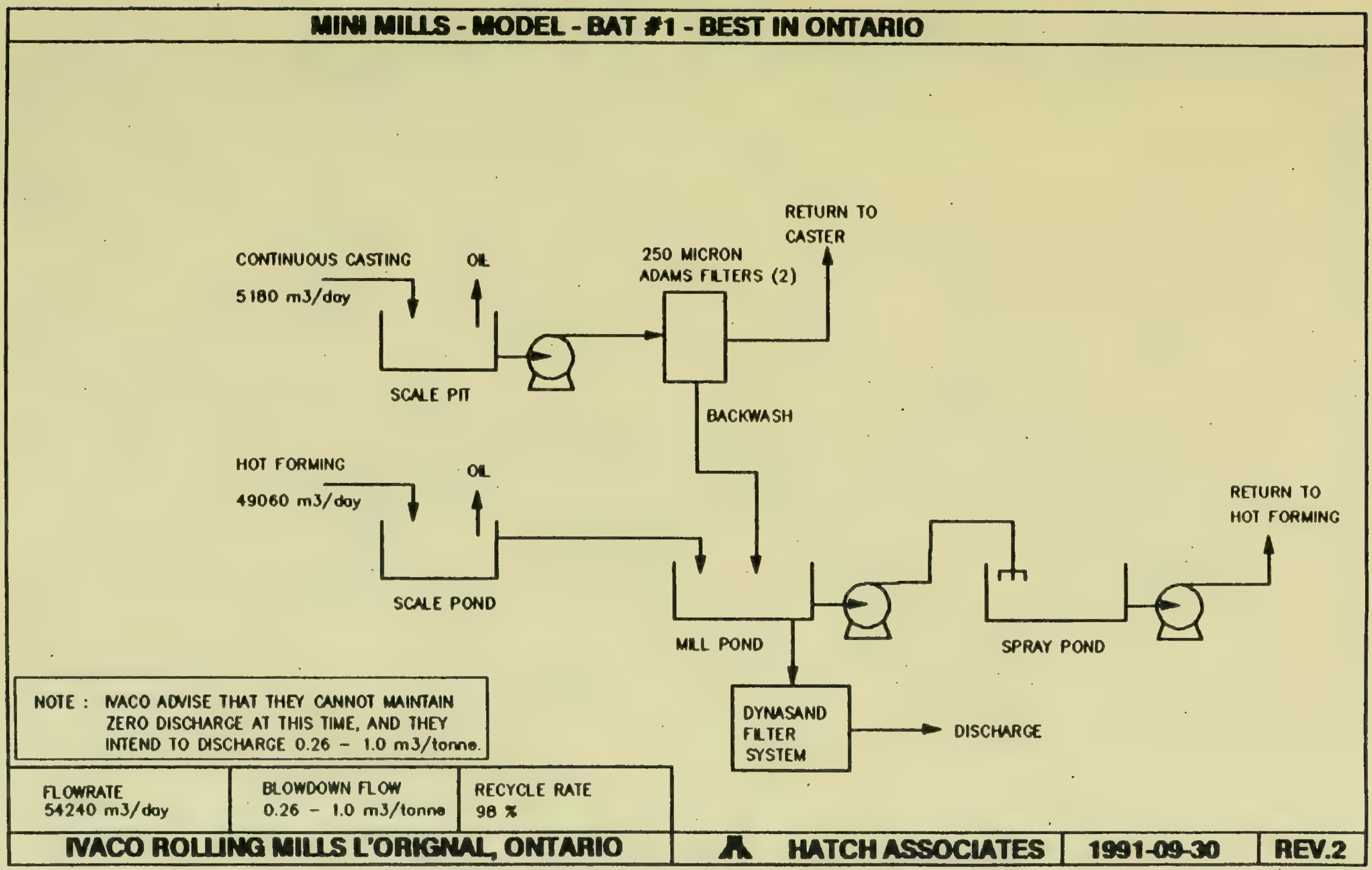

MINI MILLS - MODEL - BAT #1 - BEST IN ONTARIO
CONTINUOUS CASTING
5180 m3/day
OIL
SCALE PIT
250 MICRON
ADAMS FILTERS (2)
RETURN TO
CASTER
BACKWASH
HOT FORMING
49060 m3/day
OIL
SCALE POND
MILL POND
SPRAY POND
RETURN TO
HOT FORMING
DYNASAND
FILTER
SYSTEM
DISCHARGE
NOTE : IVACO ADVISE THAT THEY CANNOT MAINTAIN ZERO DISCHARGE AT THIS TIME, AND THEY INTEND TO DISCHARGE 0.26 – 1.0 m3/tonne.
FLOWRATE
54240 m3/day
BLOWDOWN FLOW
0.26 – 1.0 m3/tonne
RECYCLE RATE
98 %
IVACO ROLLING MILLS L'ORIGNAL, ONTARIO
HATCH ASSOCIATES
1991-09-30
REV.2

FIGURE 5.15.1

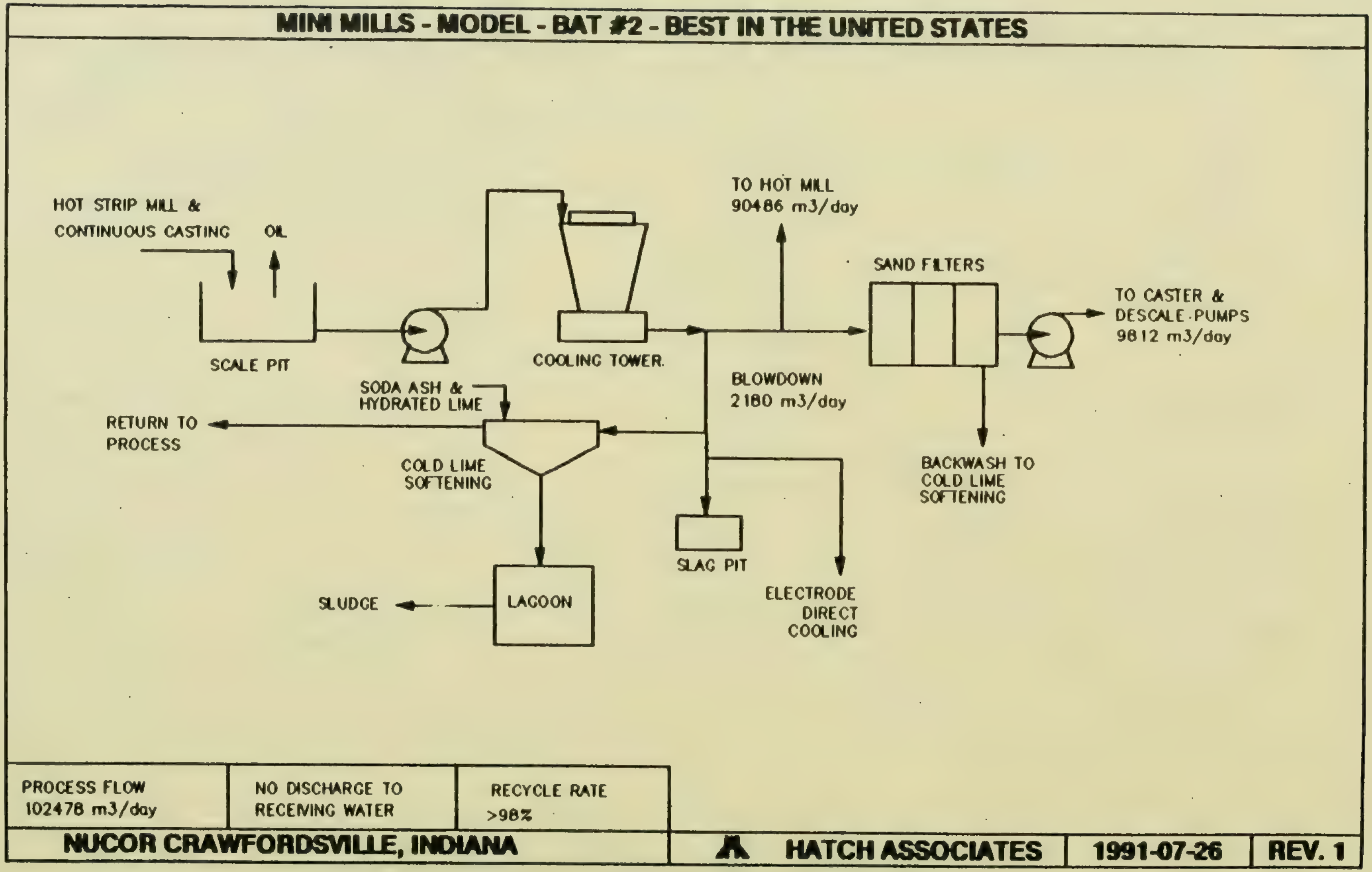

MINI MILLS - MODEL - BAT #2 - BEST IN THE UNITED STATES
HOT STRIP MILL & CONTINUOUS CASTING
OIL
SCALE PIT
COOLING TOWER.
TO HOT MILL 90486 m3/day
SAND FILTERS
TO CASTER & DESCALE PUMPS 9812 m3/day
BLOWDOWN 2180 m3/day
BACKWASH TO COLD LIME SOFTENING
SODA ASH & HYDRATED LIME
RETURN TO PROCESS
COLD LIME SOFTENING
SLAG PIT
ELECTRODE DIRECT COOLING
LAGOON
SLUDGE
PROCESS FLOW 102478 m3/day
NO DISCHARGE TO RECEIVING WATER
RECYCLE RATE >98%
NUCOR CRAWFORDSVILLE, INDIANA
HATCH ASSOCIATES
1991-07-26
REV. 1

FIGURE 5.15.2

PREDICTED EFFLUENT QUALITY

MINI MILLS – GENERIC

BAT	BAT #1		BAT #2	BAT #3	BAT #4	BAT #5
Mill	IVACO (Note 1)		Nucor, Crawfordsville			
Flow (m3/tonne)	1.0					
Parameter	Average Conc. (mg/L)	Average Loading (g/tonne)				
TSS	10	10	Zero effluent, (Note 2).	See BAT #2.	Zero effluent.	Zero effluent.
oil and grease	5	5				
lead	–	–				
zinc	–	–				

Notes:
1. During the MISA monitoring period Ivaco, operating in experimental mode, did not discharge any effluent. Ivaco advise that they cannot maintain this mode of operation and they intend to discharge an average of 0.26 m3/tonne to a maximum of 1.0 m3/tonne. Average expected blowdown concentrations were estimated by Ivaco to be < 10 mg/L TSS and < 5 mg/L oil and grease. Average Loading was calculated from Average Concentration and Flow.
2. Nucor, Crawfordsville achieves zero discharge partly by evaporating blowdown on Slag and partly by evaporation for electrode cooling.

1991–09–20	TABLE 5.15.1	HATCH ASSOCIATES	PEQMMGEN.WK1 PEQMMGEN.ALL	REV. # 2

6.0 POLLUTION PREVENTION: EMERGING TECHNOLOGIES AND INDUSTRY TRENDS AND PROGRESS TOWARDS VIRTUAL ELIMINATION

6.1 Introduction

The long term goal of virtually eliminating persistent toxic compounds from wastewater discharges can best be achieved by process changes, raw materials substitution, best management practices and modified environmental control systems which do not use water or use substantially less water. With the exception of best management practices, these approaches are very major steps which could be taken in the longer term after the installation of more conventional water conservation and treatment systems.

One advantage of most of the emerging technologies is that they also bring productivity and other cost savings to an operation. These savings include the reduction of labour requirements, reduction in energy costs, cheaper raw materials and the elimination of the need for conventional treatment systems. These benefits can be most economically achieved when a greenfield site or a major retrofit is being constructed.

Process changes and raw materials substitution will not likely always achieve virtual elimination. There will inevitably be some aqueous streams which must be treated, prior to recycle, by more advanced end-of-pipe treatment technologies than are currently available. Emerging processes of this type should be considered as well.

Overall, the emerging technologies can be grouped as follows:

- Improved gas cleaning systems, particularly those that do not use water.
- Process modifications, including raw materials substitution.
- Advanced water treatment systems.

The impact of inter-media transfer of pollutants should be considered in evaluating the above. It is likely that such occurrences can be handled effectively, and the costs of doing so are likely to be far outweighed by the advantages of the improved process. For example one emerging

process for the production of coke does not involve the recovery of chemicals as a by-product, thus eliminating most of the major water pollution (as well as air pollution). However, the gas will be oxidized and then cleaned to remove particulates; this cleaning step is more economical and likely to be more effective than attempting to achieve the same recovery of pollutants from wastewater.

As noted earlier in this report, the emerging technologies discussed herein are not well enough established, nor is there sufficient technical and cost data available, that they can be considered as potential BAT. However, it is clear that many of these technologies will slowly be adopted by the North American iron and steel industry, and many will likely be standard practice within 15 to 20 years.

The more important of the emerging technologies are described in the following sections. The purpose is to inform industry and the government about the nature and impact of these processes, so that the short term decisions on limits will fully take into consideration the likely changes to the processes in the future.

Discussions of specific technologies are grouped according to process categories whose effluent would be most beneficially affected.

6.2 Cokemaking

For integrated mills, it is the Cokemaking process which is of greatest concern, not only the aqueous discharges but also air emissions. There are three promising options to reduce or eliminate environmental problems.:

- Pulverized Coal Injection (to Blast Furnace tuyeres),
- Non-recovery (of by-products) Cokemaking,
- Direct Ironmaking or Steelmaking.

Pulverized Coal Injection (PCI): Many companies are modifying or are studying means of modifying Blast Furnace practice so that coal or other fuels (such as tars) can be injected as fuel through the tuyeres. This provides some of the energy which would otherwise be supplied by coke, and has the potential to reduce the amount of coke used per tonne of pig iron by as much as 40 percent.

Approximately 60 percent of ironmaking blast furnaces in Japan presently use PCI. For example, blast furnaces #2 and #3 at Kobe Steel operate with a coal injection rate of more than 100 kg per tonne of hot metal. The #2 furnace is very large, with an inner volume of 3850 m^3. Testwork at Kobe shows that they could achieve a PCI rate of 200 kg per tonne of hot metal by optimizing their existing operation.

HA noted in the Hoogovens Mill Visit Report Volume III -(see Appendix C) that their Blast Furnaces 6 and 7 use a coal injection rate of 200 kg/tonne, thereby reducing the coking rate to a very low 300 kg/tonne of pig iron. In addition, it has been reported that the Tarranto Steel Mill in Italy will have coal injection by 1992 to replace 44 percent of the coke required. USX plans to convert 80 percent of its Blast Furnaces to Pulverized Coal Injection by 1996. Canadian producers have similar plans.

There are significant advantages for injecting coal through the tuyeres. As noted above, it substantially reduces the amount of coke required per tonne of hot metal. The capital cost for coal injection is far below that of coke oven plants of equivalent capacity (per tonne of hot metal), providing a substantial economic incentive. Also, a much wider range of coals can be used because the coking properties of the coal are no longer important.

The environmental problems are much less severe with PCI. Volatile organic compounds are decomposed at the high blast temperatures (about 1250°C) where the coal is injected. Potential problems from fine coal dust can be easily controlled by conventional methods. Of course, fugitive dust collected is also injected into the blast furnace.

The blast furnace operation must use a certain amount of coke to support the burden in the shaft as the iron and slag constituents melt near the tuyeres. Thus, not all of the coke can be replaced by coal. At present, it appears that about 40 percent replacement of coke by coal seems practical.

Non-recovery Coking: Sun Coal Company in the USA, a division of Sun Oil Company, is developing a Cokemaking process which would produce off-gas for combustion and co-generation, rather than for the recovery of tars, oils and chemicals. The ovens are semi-cylindrical in shape and can be constructed at low cost. Coal is charged into hot ovens, and coal gases are burned above the coal and are drafted into flues under the ovens. All gases are burned and conveyed to an exhaust system to a stack. One main advantage, environmentally, is that the ovens operate under negative pressure, thus eliminating potential leakage of toxic volatile organics. Since all gases are burned, there is no need for a by-products plant. The gas would probably be cleaned by a dry electrostatic precipitator; thus no liquid effluent would result. Volatile toxic organics would be destroyed during the combustion process.

This process is still in the development stage as it is not yet clear whether or not the quality of the coke would be acceptable. Indications are positive, as coke from Sun Coal is currently used in blast furnace operations by McLouth Steel, Maryland. Also, the economics appear favourable. The production of by-product chemicals from conventional plants are not as profitable because of competition from the petrochemical and natural gas industries. The cost of constructing the semi-cylindrical ovens is far less than the slot ovens, for the same capacity. More space is needed for the same production, but this should become available as coke requirements are reduced through the use of PCI.

It is likely that there will be several installations in North America within about 10 years (especially in the U.S.A. due to provisions of the new Clean Air Act Amendments). That is, unless Direct Ironmaking or Steelmaking proves to be a better route.

Direct Ironmaking and Steelmaking: There are numerous processes being developed for direct Ironmaking or Steelmaking. All of these would eliminate the need for coke by eliminating the blast furnaces.

One such process, which is more or less typical, is being developed by the American Iron and Steel Institute (AISI). AISI is testing this process in a pilot plant near Pittsburg. This is theoretically a one-step process wherein coal, iron ore and limestone are charged into a liquid bath (in either a vertical vessel like a BOF or a horizontal vessel). Carbon monoxide (CO) gas and molten iron are generated in the vessel. Oxygen is injected into the freeboard of the vessel to burn some of the gas which, still reducing, is used to pre-reduce the ore before charging. The major parameters which are being tested are the specific capacity of the unit and the optimum level of carbon. The latter could range from near steel levels to near pig iron levels.

The Corex process consists of two steps: reduction in a shaft furnace with direct charging of the shaft furnace product into a melter/gasifier (similar to an oxygen-fired cupola). Reducing gases in the melter/gasifier are used in the shaft furnace to pre-reduce the ore. Energy is recovered from the shaft furnace off-gas which is cleaned by a dry system. This process is in commercial operation at Iscor Ltd.'s Pretoria Works in South Africa. A second unit, to produce 800,000 tonnes per year, is in the design stage.

Since the Corex process is the closest to being proven or demonstrated, it is described in Section 6.3 in more detail.

Direct reduction of iron ore pellets to sponge iron followed by electric furnace smelting to steel is already a well established process and one that is quite economical in areas where natural gas is reasonably priced. The Midrex process is in use in Canada, the USA, Europe, the Middle East, and the West Indies. Hylsa S.A., Monterrey, Mexico developed the first DRI (Direct Reduction Iron), called HYL, which has been used in Mexico successfully for many years.

6.3 Corex

In addition to its environmental advantages, Corex fills two critical gaps for steelmakers:

- For mini mills, it provides the possibility of producing hot metal at low cost even in small capacities. (This is a precondition for the successful entry of mini mills into the flat products market.)
- It allows large integrated steel producers to utilize a cost efficient unit having a tailor made capacity as a swing producer of pig iron up to 700,000 tonnes/year, or possibly more, to complement large blast furnaces.

Because it is separated into two steps, as noted above, a high degree of flexibility is gained and a wide variety of untreated coals can be used.

The process is designed to operate under elevated pressure, up to 5 bar (72 psi). Coal and iron ore are charged through a lock-hopper system. Coal is stored in a pressurized feed bin and enters the melter gasifier by a speed-controlled screw feeder. The coal then falls by gravity through the gasifier where it comes into contact with a reducing gas atmosphere at a temperature of approximately 1000 to 1200°C (1830 to 2190°F). Instantaneous drying and degasification of the coal particles occur in the upper portion of the melter gasifier. During this reaction, the coal particles decrepitate and are converted into coke.

All higher hydrocarbons will be cracked into carbon monoxide and hydrogen except for a small amount of methane. Therefore, no by-products such as tar, ammonia, benzols, etc, will be produced.

A reducing gas is generated in a fluidized bed by partial oxidation of coal. First, carbon is oxidized to carbon dioxide; then the carbon dioxide reacts with free carbon to form carbon monoxide. The gas temperature in the fluidized bed is in the range of 1600 to 1700°C (2910 to 3090°F). Temperature conditions in the freeboard zone above the fluidized bed guarantee production of a quality reducing gas which contains 65 to 70% carbon monoxide, 20 to 25% hydrogen and 2 to 4% carbon dioxide. The remaining constituents are methane, nitrogen and steam.

After leaving the melter gasifier, the hot gasifier gas is mixed with cooling gas to attain a temperature of approximately 850°C (1560°F). The gas is then cleaned in hot cyclones and fed to the shaft furnace as reducing gas. A small amount of the cleaned gas is converted to cooling gas in a gas cooler.

The fines captured in the hot cyclone are recirculated into the gasifier via dust burners.

The reducing gas is fed into the reduction shaft furnace and ascends through the iron ore burden according to the counter-flow principle. The iron ore, charged into the furnace through a lock-hopper system, descends by gravity.

The direct reduced iron (DRI) is transferred from the reduction furnace to the melter gasifier by a controllable transport system that discharges the hot material by screw feeders into connected downcomers. DRI metallization averages 95% with a carbon content of 3 to 6%, depending on the raw material used and operating conditions.

The reduction reaction in the shaft furnace, which uses gas with approximately 70% carbon monoxide and 25% hydrogen is exothermic, leading to temperatures in the burden that are above the reducing gas temperature. Carbon, obtained by carbon monoxide decomposition, forms on the iron and acts as a lubricant, thus sticking is avoid. The formation of Fe_3C also takes place. The top gas is cleaned and cooled in a scrubber, and is then available for export purposes.

The hot DRI with a temperature of 850°C (1560°F) is charged continuously to the melter gasifier, by means of the transport system described previously. The velocity of fall of the sponge iron particles is reduced in the fluidized bed so that complete reduction, heating and melting occurs. Liquid hot metal and slag drop to the bottom of the melter gasifier and are discharged by conventional tapping procedures similar to those used in blast furnaces.

The hot metal tapping temperatures can be controlled in the range of 1400 to 1600°C (2550 to 2910°F). Gasification and sponge iron throughput are controlled so that the energy balance in the fluidized bed remains in equilibrium.

Tapping is carried out every 2.5 to 3 hr on an average. The quantity of hot metal tapped in the pilot demonstration plant varied up to 20 tonnes per tap; in the commercial plant at ISCOR, 100 to 120 tonnes are tapped at one time.

For good desulphurization, a slag basicity above 1.0 is employed, ie, $(CaO + MgO)/(SiO_2 + Al_2O8_3) > 1.0$.

The carbon dioxide content of the reducing gas leaving the gasifier is the overall controlling parameter. It primarily influences the carbon content of the sponge iron and the degree of metallization. The current sponge iron carbon content leads to high carbon levels in the hot metal and a low FeO content in the slag. This is also necessary for a good sulfur distribution between slag and metal.

The composition of the hot metal produced in the a Corex process is identical with that obtained in a blast furnace, provided that the raw materials do not have an exceptional impurities. This is because the preconditions and metallurgical reactions are nearly the same in the two processes.

In the Corex process, the molten metal in the gasifier drops through a layer of coke particles and liquid slag and remains in contact with both for a finite time before being collected in the hearth. Thus, the carburization and desulfurization reaction can take place in the same manner as in a blast furnace. Slag volume, basicity and FeO content of the slag also determine the sulfur distribution in the same way as that occurring in a blast furnace operation. The silicon content of the hot metal depends on the hot metal and slag temperature and can be influenced by the charging rate of the sponge iron to the gasifier.

Corex hot metal composition depends on the operating conditions and raw materials charged. A typical range of composition is: C 3.80 to 4.20%; S 0.02 to 0.08%; and Si 0.30 to 0.60%.

In some cases, the sulfur input from a low-grade coal can exceed the desulfurizing capacity of the slag. This condition causes higher sulfur contents in the hot metal and external desulfurization is needed. On the other hand, an external desulfurization might also be necessary if, for economical reasons, the slag basicity is kept low or there is a demand for extra low sulfur metal from the steel plant.

The chemical composition and temperature of the hot metal produced by the Corex process is well suited for BOF steelmaking. Therefore, the process can either replace blast furnaces in capacities ranging from 300,000 to 700,000 tonnes/year in existing integrated steel plants or serve as a swing producer of hot metal to complement large blast furnace operations. Compared to the conventional coke-oven/blast furnace route, the process has much lower specific investment costs. These lower costs are mainly the result of the absence of a coke-oven plant. The costs are in the range of US$250/annual tonne vs US$220 to $390/annual tonne for the coke-oven/blast furnace route.

The lower investment cost also influences the cost of hot metal. The Corex hot metal cost is 32% lower than from the blast furnace. These savings are mainly due to net energy cost savings, labour cost savings and investment cost savings.

Assuming that the cost for further processing of hot metal to steel will be the same in both cases, there will be a net saving of US$66/tonne of steel.

6.4 Ironmaking

The Direct Ironmaking and Steelmaking processes discussed above are emerging technologies which represent trends towards virtual elimination for this category.

6.5 Steelmaking

Mini Mills: Downsizing of major steel companies in North America and the increase in the availability of scrap has led to the growth of the so-called mini mills which produce steel from scrap in electric arc furnaces. These are useful operations because their main feed is material which would otherwise be landfilled. Normally the electric furnace off-gas is cleaned by baghouses. Thus, there is no discharge of process water from steelmaking. As noted in Section 6.2, sponge mini pellets (DRI) can be used as feedstock to an electric furnace when scrap is not available.

However, there is one major environmental concern with this technology. This is the production of high zinc flue dust during smelting of scrap in the electric furnace. This dust cannot be replaced and to date there is no satisfactory way of re-processing it. It is either stockpiled on site or sent to hazardous waste treatment facilities. The latter are secure landfills or re-processing at a central facility (eg. Horsehead Resources). Shipping off-site is costly and likely only a short term solution as the transport of hazardous wastes is likely to be banned in the future. For this reason, electric furnace steelmaking cannot be considered BAT technology. This could change in the future if economical processes to treat these dusts for the recovery of zinc are demonstrated. One promising approach is a hydrometallurgical process presently being developed by Hatch, Chapparal Steel and Big River Zinc.

Corex does not have this disadvantage as it uses iron ore pellets as feed stock. The drawback to using DRI in the electric furnace is the much higher cost of energy compared with Corex.

The term "mini mill" is now somewhat of a misnomer in North America. Electric furnaces can produce as much as 130 tonnes per hour of steel, not much less than typical BOF's at about 250 tonnes per hour. In addition, one mini mill producer, Nucor Corp. in the USA, ranked seventh among North American steel companies in production in 1990. Nucor produced about 3.8 million tonnes of steel. North Star Steel Co., another mini mill company, ranked eighth. About one-third of steel production in North America in 1990 came from mini mills.

Dry Gas Cleaning: Modern steelmaking practice in the conventional integrated mills utilizes basic oxygen furnaces (BOF's) and collection of the reducing off-gas for re-use in the process. This off-gas is usually cleaned by wet scrubbing. Operations with a high recycle rate use scrubber water relatively efficiently. However, emerging dry cleaning technology is much more energy efficient and uses no water. The Lurgi-Thyssen system is one example, now in use at the Thyssen steelworks in Germany and at the Kwangyang Works of POSCO in South Korea. This practice is not widespread, thus substantial development work must still be done for each specific application. (Dry cleaning of fully combusted gas is well established. However, the industry trend is towards recovery of the CO gas).

6.6 Continuous Casting/Hot Forming

The main new developments in these areas are the attempts at what is known as "near net casting". This is, in its ultimate form, the direct casting of steel from the steelmaking vessel into a form as close as possible to the shipping product. Major reduction in capital, energy and water requirements would result from implementation of this technology.

To-date continuous casting has replaced the casting of ingots and is considered standard practise. It is now practical to consider that Hot Forming and Hot Strip Milling could be replaced by "near net casting". Elimination of these operations would greatly reduce water and energy requirements in steelmaking. That this is now a practical to consider is illustrated by the following examples.

Thin slab casting is being practised by Nucor at its plant in Crawfordsville, N.C., USA.

Chapparel Steel (Mid-Rothian, Texas) has successfully completed pilot testing of casting beam blanks. (These do not require further working as do the so-called "dog bone" beam blanks which have been produced by Algoma Steel.)

Steel Casting Engineering cast mild steel rods close to the finished size in two production units.

Allegheny Ludlum, in its plant in Rockport, N.Y., USA, is now using a process which avoids hot rolling. It is producing <5mm stainless strip on a (24 inch) fall scale single caster.

Mannesmann Demag of Germany claims it has developed a process which reduces slabs immediately and winds them into coils. No application has been reported.

Projet Bessemer in Canada will test the feasibility of casting flat products less than 5 millimetres, including 3 mm strip. This would eliminate Hot Forming and the Hot Strip Mill. The project, which is being jointly financed by governments and steel companies in Quebec and Ontario is in the planning stage.

6.7 Finishing

Stainless steel pickling with hydrofluoric and nitric acid produces acid wastes which must be neutralized. Significant quantities of nitrates and heavy metals remain in the wastewaters, and a toxic sludge is produced. Ion exchange and electro-dialysis processes are being developed to remove, regenerate and recycle free and combined acid from the effluent.

6.8 Alternatives to Chlorination in Wastewater Treatment

Concern has been expressed over the use of chlorine in wastewater treatment plants. Chlorinated organics, particularly chlorinated aliphatic compounds and chlorinated aromatics, are of concern with respect to ecosystem health and ultimately human health.

Chlorine is of course widely used (and required by MOE) as a disinfectant for treated municipal wastewater prior to discharge to receiving waters. Alternative methods of disinfection are being considered, such as ultra-violet radiation and ozonation.

Chlorine addition is used in wastewater treatment in Ontario at Lake Erie Works as an aggressive oxidant to convert cyanide via cyanate to carbon dioxide and nitrogen (alkaline chlorination process), and for conversion of ammonia to chlorides, nitrogen and water via the chlorinamination mechanism (breakpoint chlorination). Certain operating conditions can result in the production of chlorinated organics in the effluent. MISA monitoring data for MIDES #0100

at Stelco LEW does not indicate the presence of any chlorinated aromatics; however, bromoform, chloroform, and dibromochloromethane were all found at >LMDL levels.

Alternative technologies to accomplish reductions in cyanide and ammonia levels are alternative oxidation mechanisms. For example, ultraviolet radiation with ozone addition or catalysed ozone oxidation are reported as successful alternative methods for complex cyanide removal. In addition, for ammonia conversion, ion exchange is practised at some municipal plants in the U.S.

Dechlorination to remove residual chlorine is accomplished at LEW to 70-75% reduction in Pond 4. Other proven methods to accomplish this are sulphur dioxide or sulphite addition or activated carbon treatment. Activated carbon may also reduce the residual chlorinated organic compounds discharged.

7.0 APPLICATION AND COSTING OF MODEL BAT TECHNOLOGY TO ONTARIO MILLS

7.1 Application of Model BAT Technologies

In the following sections of this report, the "Model" Best Available Technologies for each process category are applied to the existing process categories at each of the Ontario Mills.

For each process category the applied technology train is described; schematic flow sheets are shown; existing and predicted effluent quality is tabulated; and estimated costs to implement the technology are presented.

The applied technology train description is specifically a transfer of the actual demonstrated best available technology in use at the mills identified as Best in Ontario (BAT#1), or Best in USA (BAT#2), or Best at Selected World Locations (BAT #3). No attempt is made to assess whether or not the technology represents best current design practice, nor to improve, edit, or modify what actually is in use at the BAT mills. In some cases existing wastewater treatment units at the Ontario Mills constitute a portion of, or are similar to BAT, and this has been considered where appropriate. The schematic flow sheets reflect the same approach.

It should be noted that in some cases, technology trains designed today would be different to actual BAT's in existence and operating. An example would be the installation of a sand filter in some instances instead of a clarifier as these may produce lower suspended solids. Equipment and process technology is constantly improving. In other cases, some technology trains are not operated exactly as designed and some process units identified might have become redundant. An example would be the primary clarifier in Lake Erie Works, biotreatment system which was installed when lime was used in the Ammonia Still. Caustic is now used, making this clarifier redundant.

The technology trains do however provide a clear indication of the effluent characteristics achieved at those mills selected for BAT's. The technology (and the effluent characteristics) are

considered transferable between generally similar processes. However, no two plants are identical, each being unique with regard to age of process units, modifications since initial installation, interaction with other process units, water chemistry, etcetera. Therefore some differences in raw and treated effluent characteristics must be expected when compared with the Model BAT's. Whenever differences are known they have been noted, and where possible adjustments made (eg. Cokemaking Applied BAT #2).

The Predicted Effluent Quality Tables show both existing and predicted effluent quality for process wastewater streams. Existing mill discharge data has been reproduced from the MISA monitoring data obtained during the MISA monitoring period. This data is not available for each process category since in many cases effluent streams from several different processes are combined before discharge to the receiving water (usually the location of the MISA Monitoring Station). In many instances MISA monitoring points are such that process water, Non-Contact Cooling water and Stormwater are combined before the monitoring point. The data has been reported as measured and is so noted.

The applied or predicted BAT effluent quality data was calculated by multiplying the Model BAT data (m^3/tonne or g/tonne) by the specific mill category production in tonne/day. The production values were the long-term average values reported for the MISA monitoring period. Concentration values were not calculated from the predicted applied loadings and flows but were reported exactly as shown in the Model BAT effluent data sheets. If the concentrations had been calculated from the predicted applied loadings and flows, they would differ slightly from the Model BAT concentration due to rounding. No reliable data or methodology exists to "separate" the NCCW or Stormwater flows from these different sources for existing mills. Data will therefore be accurately representative of total load (kg/d) of contaminants discharged, but may not be accurately representative of concentration in process effluents. BAT#1 and BAT#2 are process flows only, (no NCCW or Stormwater Component).

As discussed in Volume I, the approach taken to assess BAT #3 was to evaluate discharge loadings from the BAT #1, BAT #2 and overseas mills visited to determine the mill with the least

emissions. This was then selected as the BAT #3 mill and the technology applied to Ontario Mills whenever practical.

The approach to assess BAT #4 presumes that the Best Available Technology #3 has been implemented and then the resulting effluent assessed for toxicity. The flow (m^3/tonne) and loading values (g/tonne) from Model BAT#3 are used to predict effluent characteristics for Applied BAT#3. It follows, therefore, that the assessment for Applied BAT#4 will be similar to assessment for the Model BAT#4 for each process category, since the predicted effluent contaminant concentrations are the same.

The procedure for assessing toxicity was similar to that outlined for the Model BAT's. Each process category Predicted Effluent Quality has been reviewed against known single contaminant LC50 toxicity concentration level. Some LC50 threshold levels published are lowest levels, and some actual LC50 levels vary according to (1) hardness (Cadmium, Chromium, Lead, Nickel, Zinc) or (2) pH and temperature (Ammonia).

For this assessment three possibilities were identified:

1. The predicted effluent would probably fail the Ontario Toxicity Test because at least one contaminant exceeds the published LC50 level. This assessment does not take account of hardness, pH and temperature, since these will vary, and they are not known for each effluent.

2. The predicted effluent would be marginal to pass the Ontario Toxicity Test, since no estimate of the synergistic effect of several contaminants at or below the LC50 is possible, and no direct testing has been carried out.

3. Based on actual testing of this, or similar effluent, the predicted effluents will likely pass the Ontario Toxicity Test.

Direct Toxicity Testing of actual effluents is the only reliable method of evaluating toxicity.

"Process category" toxicity assessment tends to be unrealistic when compared with an actual mill collection and discharge system. In practice, mill wastewater collection systems are complex to say the least, and "process category" wastewaters often do not discharge at one point or into one pipe. Two additional factors complicate matters further in this regard. Firstly, process wastewater is frequently combined with non-contact cooling water and stormwater for convenience of conveyance prior to discharge to the receiving water. Secondly, three of the large integrated mills in Ontario have central treatment plants which treat combined process wastewater prior to discharge to the receiving water. Typically toxicity is measured at the point of discharge to the receiving water, (not internally in the mill collection system). For these reasons process category (eg. cokemaking effluent) is not discharged directly to receiving waters and toxicity assessment of this stream in isolation is not meaningful.

Stelco's Lake Erie Works, (selected as BAT#3), generally has a separate process wastewater sewer system. The effluent from this plant consistently passed the Ontario Toxicity Test for Rainbow Trout, and 10 out of 12 times for Daphnia Magna. The cause of the 2 failed Daphnia Magna tests is not known.

Similarly, BAT #5 is assessed by presuming that BAT #3 has been implemented and the effluent is assessed for virtual elimination of persistent toxics. The conclusions for the Model BAT #5 will be valid for the Applied BAT #5 for each process category since the concentrations are the same.

As discussed fully in Volume 1 of this Report, Model BAT#5 Stelco Lake Erie Works may have already achieved "Virtual Elimination of Persistent Toxics", depending on how this is eventually defined.

In view of the uncertainty relating to this issue, and the "not demonstrated" process technology required to achieve zero discharge, no estimates of cost for achieving BAT#5 are included at this

time. It is not clear if zero discharge is required to achieve "virtual elimination", nor exactly which process would successfully accomplish zero discharge. Material substitution and process changes are discussed in Section 6.0. These, in the longer term, offer the best possibilities for achieving zero discharge.

Finally, in order to address the issue of Integrated Mills with common or central treatment facilities (Algoma, Stelco Hilton, Stelco LEW), a separate process category was established to review total mill operation based on steel production. This category has two parts, these were Integrated Mills - Including Finishing, and Integrated Mills - Excluding Finishing.

For this process category, whilst overall predicted effluent quality is an interesting comparison, it is somewhat limited in its usefulness for two reasons. Firstly, mills with central treatment systems are not common in the USA so that limited directly comparative data was available, and this has been supplemented with "hybrid" mill data as outlined in the Model BAT's. Hybrid data is the sum of the best available technologies for each process category taken from several plants. However, the hybrid data is less satisfactory than directly comparable data. Secondly, within each integrated mill specific process category production (e.g. coke, hot forming, finishing) production tonnes, will vary. Expressing emission loadings as g/tonne steel produced is an approximation, which can lead to inaccuracies when reviewing process category operations.

The tables, "Predicted Effluent Quality-Integrated Mills-Including Finishing", for Algoma, Dofasco and Stelco Hilton, summarize the Applied BAT options for the Integrated Mills category. This comparison is presented for information purposes only. Clearly the mills are not directly comparable in terms of production facilities and/or wastewater treatment approaches. The data is presented in an attempt to provide some comparison for the central treatment systems at Stelco Hilton and Algoma. Dofasco does not utilise a central wastewater treatment plant approach and is more comparable to BAT #2B. As detailed in Volume I, BAT #1 includes Stelco LEW's final effluent and Dofasco's finishing effluent; BAT #2-A is an integrated mill with central treatment facilities and finishing operations, National Steel, Granite City; BAT #2-B represents the sum of the Model BAT #2 options for all sub-categories; and BAT #3 is Stelco LEW with

National Steel Midwest for the Finishing component. The tables were calculated by multiplying the main component of the Model BAT data (m^3/tonne and g/tonne) by the Steelmaking production at the specific mill, multiplying the product of the Finishing component of the Model BAT data by the acid pickling production at the specific mill and adding the two components.

Similarly, the table "Predicted Effluent Quality-Integrated Mills-Excluding Finishing" for Stelco LEW, summarizes the Applied BAT options for the Integrated mills category. This comparison is presented for information purposes only. Clearly the mills are not directly comparable in terms of production facilities and/or wastewater treatment approaches. The data is presented in an attempt to provide some comparison for the central treatment system at Stelco LEW. As detailed in Volume I, BAT #1, Stelco LEW is an integrated mill with central treatment facilities but no finishing operations; BAT #2-A, National Steel Granite City, is an integrated mill with central treatment facilities and finishing operations (data adjusted to delete the finishing component); BAT #2-B represents the sum of the flow and pollutant loading data for the Model BAT #2 of all process categories; and BAT #2-C, LTV, Cleveland, represents an integrated mill with no central treatment facilities. The table was calculated by multiplying the model BAT data (m^3/tonne and g/tonne) by the Steelmaking Production at Stelco LEW.

7.2 Costing of Applied Technologies

The cost estimates prepared for this report are those costs required to retrofit the selected technology train to permit an Ontario Mill to attain a similar effluent quality to that achieved by the BAT mill. These cost estimates should not be construed as representing costs required to meet effluent regulations yet to be developed under the MISA program, since these parameter limits are not known at this time.

The following information supplements the general description of our approach to costing which is described in Volume I Section 1.4.

In order to produce cost estimates for the Applied BAT's, process flowsheets were developed to represent the retrofit of a BAT technology into existing facilities. A list of main plant equipment

items was generated and these items were costed. Treatment flows (m^3/day) were estimated based on BAT flowrates (m^3/tonne) and rated production capacities (tonnes/day). These flows were used to size the equipment for the Applied BAT. Once the installed costs had been calculated a contingency of 25% was applied. This quantity is intended to allow for unforeseen requirements and is consistent with HA's experience with similar engineering projects.

The basic methods of cost estimation for Applied BAT's include the following:

A The basis is actual cost at other facilities installed at other North American plants. This cost is escalated to 1991 costs using a factor of 1.041/yr(average of CEPC index for 1979-1988). Capacity is scaled on flowrate using 0.6 exponential factor. Where data was available from more than one location the average cost is used.

Estimated Accuracy +/- 30 %

B Hatch in-house cost data for known equipment and similar installations is used as the basis for cost development and is then either scaled or factored to give installed plant costs.

Estimated Accuracy +/- 30 %

C An equipment factored estimate is used. Prices of major equipment is obtained as budget prices from vendors. Full plant costs are estimated using factors from Peters and Timmerhaus, "Plant Design and Economics for Chemical Engineers".

Estimated Accuracy +50 / -30 %

D Crude order-of magnitude-estimate or allowance is based on quick overview of requirements.

Estimated Accuracy +100 / -50 %

This approach to estimating is commonly used for preliminary and study estimates. This type of estimate should not generally be used as a basis for investment decisions. Rather it is intended that the Ministry of the Environment use these figures to assist in assessing options. The general overall accuracy of the estimates is expected to be +/- 30 %.

In order to lend more accuracy to the cost estimation process, costs were reviewed with the respective facilities in order to provide additional detail to the level of complexity expected in the proposed retrofit. Facilities that participated in this review process included Dofasco, Stelco Hilton, Stelco LEW, Atlas Steels and Ivaco. Facilities personnel were given the opportunity to comment on the cost estimates as well as to provide additional information pertinent to the costing of the Applied BAT to their facility. This method of review resulted in cost estimates that we believe are generous and allow for unforeseen costs. Thus, every effort has been made to accommodate the concerns expressed by industry. In a similar exercise conducted by the US EPA, it was found that cost estimates in almost every case were higher than the actual cost of implementing the Applied BAT and/or meeting the discharge criteria set by the EPA.

The costs included in this report are based on HA's estimate of how systems in existing facilities should be retrofitted to achieve similar effluent loadings to the facilities identified as Model BAT's. It is expected that, in some cases, more economically feasible options will undoubtedly be identified and investigated if companies are faced with meeting BAT technology equivalents. New processes and technologies might prove to be successful in reaching or exceeding BAT loading limits. These are obviously outside of the scope of the present project. However, in the short term we believe that these technologies will be of the same order of capital cost as those reported herein.

Operating costs were ratioed based on costs from existing facilities based on the flows to be treated. While it is realized that the different effluent loadings in the streams at other facilities will greatly affect the quantity of chemicals to be used for treatment, HA believes that these estimated costs are well within the accuracy of this costing exercise. For utility costs every effort has been made to account for utility requirements for the new equipment. For pumping costs,

a pump efficiency of 50% and a pressure drop of 50 psi have been used to determine power requirements. HA believes these assumptions to be representative figures on average. The estimated operating costs are the same accuracy as the plant cost estimates.

Operating costs are incremental but do assume a stand-alone sub-category - ie. treatment of a waste stream from the sub-category, by itself. Operating labour does not include maintenance or supervision. Maintenance labour is part of the maintenance allowance. None of the facilities proposed would need additional supervision in a retro-fit situation.

7.3 Non-Water Quality Impacts

Most of the Applied BAT's involve the installation of biological treatment, chemical treatment, solids removal, or recycle systems, or any combination of the foregoing. The impacts of these process additions on air quality are not estimated, but we believe that they are not significant. (For example, organic compounds might volatilize from cokemaking wastewater streams during biological treatments).

The introduction of dry gas cleaning in steelmaking would, if anything, reduce the emissions of particulates to the atmosphere. Very small quantities of the water soluble vapour compounds would not be collected. However, these quantities would be so small that it would be difficult to even measure the increase. Sulphur oxide compounds are examples.

Any transfer of pollutants to the air as a result of introducing BAT Technology would be insignificant in comparison to current limits. Potential increase in air pollution associated with BAT's requiring high energy increases has also not been addressed directly.

There is an increase in the generation of solid wastes as a result of increased removal of pollutants from wastewaters. The quantities of these are estimated and included in the sections describing the Applied BAT's. However, with a few exceptions, these quantities are not significant with respect to the solid wastes currently being generated by the operations as a whole. In addition, it is likely that means for recycling these wastes will be developed. Reliable

technical and cost data is not available because these technologies are not well established. However, it is our opinion that when the cost of disposal reaches about $200 per tonne for an extended period, there are processes available to handle these wastes at less cost. Thus, $200 per tonne has been used as disposal cost in this study.

Energy consumption will increase substantially with the addition of recycle systems, especially for Continuous Casting and Hot Forming. These quantities are also identified in the description of the Applied BAT's. The impact in the increase in energy consumption has not been addressed in this report.

Indeed, a full cycle analysis is beyond the scope of this study as it is a very complex subject. It should be recognized that an increase in energy demand could transfer pollutants to thermal power plant off-gas. This potential, and the disadvantage of high energy consumption, has been recognized in this study by using a slightly high unit cost for power.

8.0 APPLIED BAT ALGOMA STEEL CORPORATION, SAULT STE. MARIE

8.1 Cokemaking

8.1.1 BAT #1 Best in Ontario

Algoma presently treats their cokemaking wastewater in an ammonia still for removal of free ammonia. There is also a fluidized bed biological treatment plant to further treat the wastewater. This plant has been constructed but is not yet operational. There is also a dephenolizer for phenol removal which Algoma proposes to decommission on start up of the biotreat system.

To upgrade this system to a BAT #1 level of treatment, the installation of an equalization tank before the ammonia still is required to collect the various wastewater streams. In addition, process area stormwater and drainage should be collected and treated with the wastewater. Process area stormwater consists of the pump and tank bases and any other areas clearly contaminated from coke plant by-product operations. All the cokemaking wastewater should be directed to the equalization tank. The ammonia still should be upgraded to provide removal of fixed ammonia. From the ammonia still, the wastewater flows to the fluidized bed biological treatment plant. A second stage biological reactor should be installed to provide nitrification of the wastewater. A clarifier and a thickener must be installed to settle and remove the sludge from the wastewater from the aeration basin.

A treatment plant is required as a final treatment step. The combined treatment for the Cokemaking wastewater and blowdown from Ironmaking should include equalization, metals precipitation, chlorination and filtration prior to discharge.

In addition to these modifications, the coke quench water should be recycled back to the quench tower with no overflow from the breeze basin. The makeup water to this system should be recycled water from the steel plant instead of fresh water. This treatment system is shown in Figure 8.1.1 *Algoma Steel Cokemaking Applied BAT #1 Best in Ontario.*

The predicted effluent quality data sheet for the modified treatment system is given in Table 8.1.1. The capital and operating cost data for this treatment technology are given in Tables 8.1.2 and 8.1.3.

8.1.2 BAT #2 Best in the United States

The modifications required to upgrade Algoma's Cokemaking wastewater treatment system to a BAT #2 level are similar to the BAT #1 modifications without the "Blowdown" Treatment Plant. The treatment system consists of equalization prior to the ammonia stills, upgrades to the ammonia stills to provide removal of fixed ammonia, and a second stage biological treatment plant to provide nitrification of the wastewater prior to discharge. The treatment system is described in more detail in Section 8.1.1. This treatment system is shown in Figure 8.1.2 *Algoma Steel Cokemaking Applied BAT #2 Best in the United States.*

The capital and operating cost data for this treatment technology are given in Tables 8.1.4 and Table 8.1.5.

8.1.3 BAT #3 Best at Selected World Locations

The BAT #1 Cokemaking wastewater treatment system was determined to be the best available process from a review of emissions from BAT #1, BAT #2, and overseas mills. The applied BAT #1 modifications are described in section 8.1.1.

8.1.4 BAT #4 Non-Lethal

The BAT #3 wastewater treatment technology for Cokemaking was determined to be the BAT#1 process. The applied BAT #1 modifications are outlined in section 8.1.1.

There is no specific toxicity data available for the disaggregated Cokemaking wastewater stream. However, based on an assessment of the expected effluent characteristics, specifically the single contaminant LC50 values, the effluent toxicity, as determined by the Ontario Toxicity Test, is probably marginal. The synergistic effects of the several contaminants in the effluent are not

known and cannot be predicted. No demonstrated technologies are known to further reduce the concentrations of organic toxics to lower levels than those disaggregated valves calculated for this wastewater. This stream is not likely to be discharged directly to Davignon Creek at the St. Mary's River. It is likely to be co-treated with Ironmaking and Steelmaking blowdown and possibly combined with other streams prior to discharge to a receiving water. No assessment can be made of the toxicity of this unknown effluent at this time.

8.1.5 BAT #5 Virtual Elimination of Persistent Toxics

The BAT #3 Cokemaking wastewater treatment technology was determined to be the BAT #1 treatment process. This technology is detailed in section 8.1.1.

This wastewater stream is expected to contain very low levels of benzo(a)pyrene (persistent bioaccumulative) and other organic toxics. No demonstrated technologies are known to further reduce the concentrations of organic toxics. The precise scientific definition of "virtual elimination of persistent toxics" is not established, but it is likely that this goal will be interpreted as zero discharge for persistent bioaccumulative toxics. Benzo(a)pyrene is listed in this category. No discharge to receiving water may be achieved with further treatment by ultrafiltration and ion exchange, or evaporation which may permit the treated water to be reused in other processes. However, these treatment technologies are not demonstrated in this industrial sector. Activated Carbon is a demonstrated treatment process for reduction of organics but its effectiveness to completely remove very low levels of carbon based contaminants is not known.

As outlined in Section 8.1.4 above the treated effluent is unlikely to be discharged directly to the receiving waters. After co-treatment and/or combination with other streams, the resulting effluent will probably not meet the virtual elimination criteria because of the presence of persistent bioaccumulative toxics.

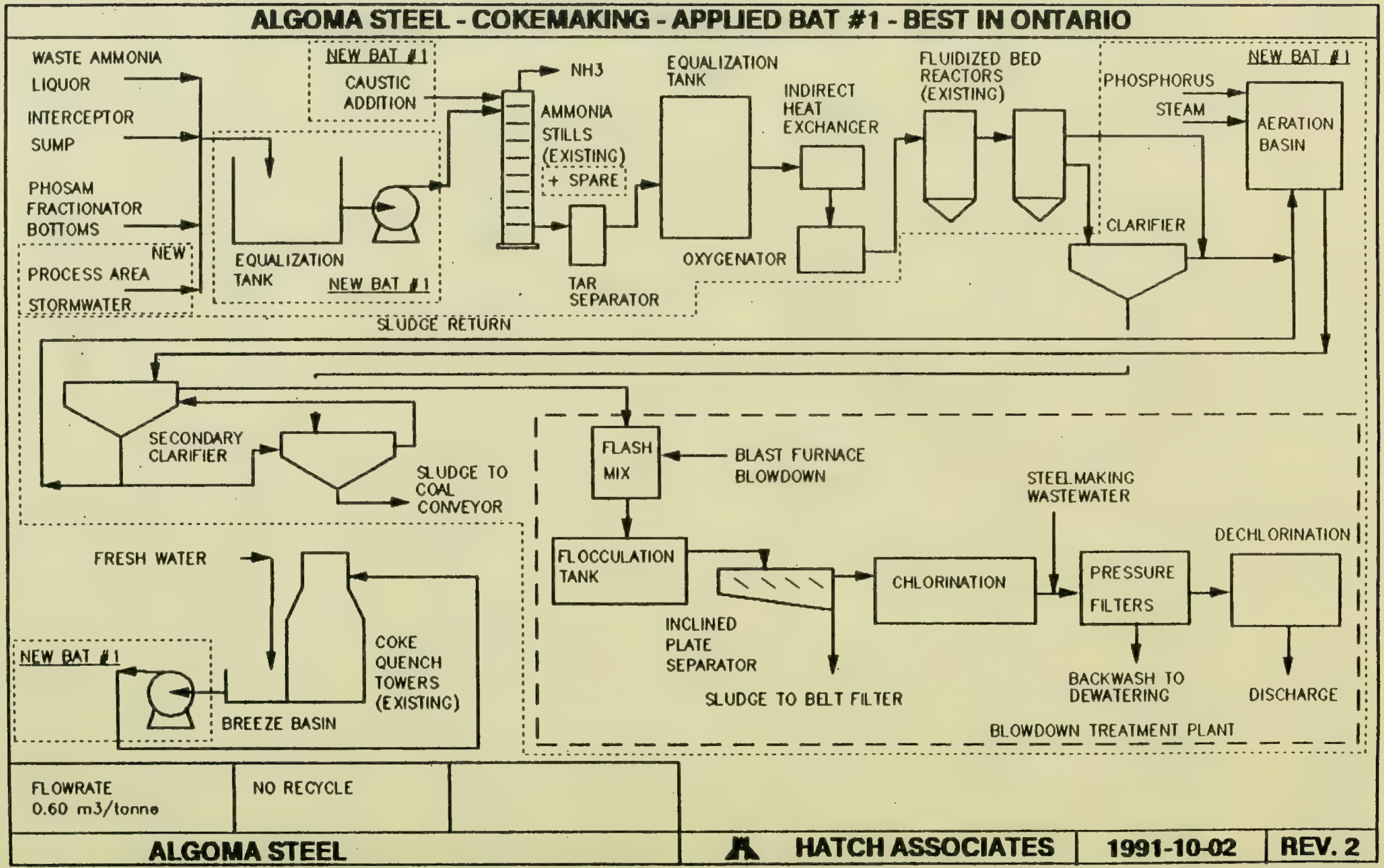

ALGOMA STEEL - COKEMAKING - APPLIED BAT #1 - BEST IN ONTARIO
WASTE AMMONIA LIQUOR
INTERCEPTOR SUMP
PHOSAM FRACTIONATOR BOTTOMS
NEW
PROCESS AREA STORMWATER
NEW BAT #1
CAUSTIC ADDITION
EQUALIZATION TANK
NEW BAT #1
NH3
AMMONIA STILLS (EXISTING)
+ SPARE
TAR SEPARATOR
EQUALIZATION TANK
INDIRECT HEAT EXCHANGER
OXYGENATOR
FLUIDIZED BED REACTORS (EXISTING)
CLARIFIER
NEW BAT #1
PHOSPHORUS
STEAM
AERATION BASIN
SLUDGE RETURN
SECONDARY CLARIFIER
SLUDGE TO COAL CONVEYOR
FLASH MIX
BLAST FURNACE BLOWDOWN
FLOCCULATION TANK
INCLINED PLATE SEPARATOR
SLUDGE TO BELT FILTER
CHLORINATION
STEELMAKING WASTEWATER
PRESSURE FILTERS
BACKWASH TO DEWATERING
DECHLORINATION
DISCHARGE
BLOWDOWN TREATMENT PLANT
FRESH WATER
COKE QUENCH TOWERS (EXISTING)
NEW BAT #1
BREEZE BASIN
FLOWRATE 0.60 m3/tonne
NO RECYCLE
ALGOMA STEEL
HATCH ASSOCIATES
1991-10-02
REV. 2

FIGURE 8.1.1

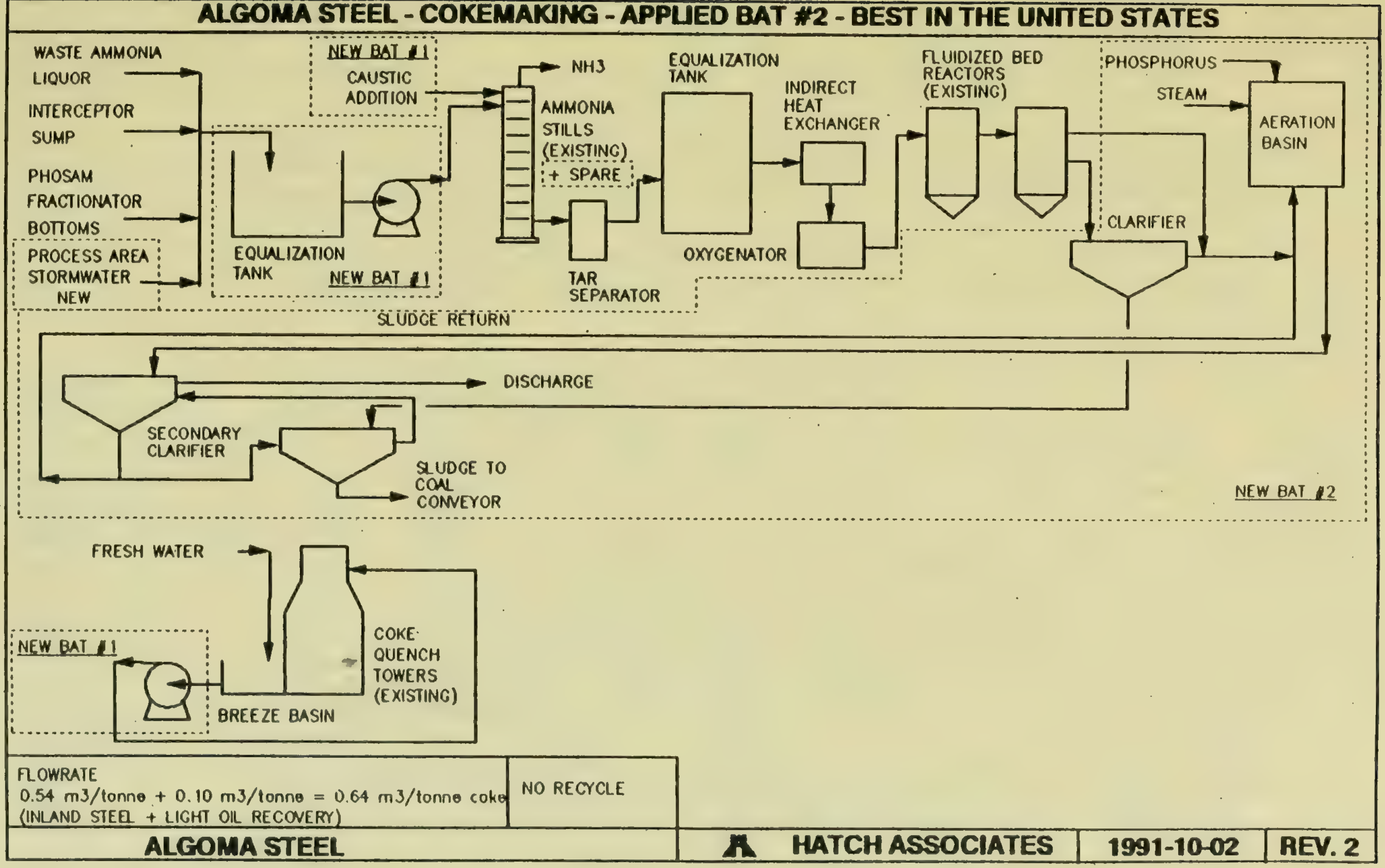

ALGOMA STEEL - COKEMAKING - APPLIED BAT #2 - BEST IN THE UNITED STATES
WASTE AMMONIA LIQUOR
INTERCEPTOR SUMP
PHOSAM FRACTIONATOR BOTTOMS
PROCESS AREA STORMWATER NEW
NEW BAT #1
CAUSTIC ADDITION
EQUALIZATION TANK
NEW BAT #1
NH3
AMMONIA STILLS (EXISTING)
+ SPARE
TAR SEPARATOR
EQUALIZATION TANK
INDIRECT HEAT EXCHANGER
OXYGENATOR
FLUIDIZED BED REACTORS (EXISTING)
PHOSPHORUS
STEAM
AERATION BASIN
CLARIFIER
SLUDGE RETURN
DISCHARGE
SECONDARY CLARIFIER
SLUDGE TO COAL CONVEYOR
NEW BAT #2
FRESH WATER
COKE QUENCH TOWERS (EXISTING)
NEW BAT #1
BREEZE BASIN
FLOWRATE
0.54 m3/tonne + 0.10 m3/tonne = 0.64 m3/tonne coke
(INLAND STEEL + LIGHT OIL RECOVERY)
NO RECYCLE
ALGOMA STEEL
HATCH ASSOCIATES
1991-10-02
REV. 2

FIGURE 8.1.2

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – COKEMAKING – ALGOMA

BAT	EXISTING (Note 1)		BAT #1		BAT #2 (Note 2)		BAT #3	BAT #4	BAT #5
Flow (m3/day)	1135		1849		1664				
Parameter	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)			
TSS	31	46	7.3	14	59	96			
oil and grease	7.6	7.1	1.4	2.7	1.3	2.1	See BAT #1.	See BAT #1.	No demonstrated technology in this industry sector.
ammonia + ammonium	978	1170	* 0.17	0.31	1.7	2.9			
cyanide total	6.2	6.3	0.93	1.7	6.9	11			
phenolics (4AAP)	13	13	0.012	0.023	0.039	0.068			
benzene	1.7	2.9	0.0052	0.0096	0.0030	0.0046			
benzo(a)pyrene	0.0048	0.0050	0.010	0.019	0.021	0.034			
naphthalene	0.017	0.015	0.0062	0.011	0.011	0.018			

Notes: 1. Average Loading direct from Algoma's MISA MIDES #1400, BY-PRODUCTS AREA. This outfall does not include Coke Quench Waste Water nor all coke plant area discharges at all times.

2. The BAT #2 flow (Inland, IH, 0.54 m3/tonne) does not include Light Oil Recovery wastewater. The EPA Development Document flow for Light Oil Recovery (0.10 m3/tonne) was added to the BAT #2 flow for costing purposes.

* less than RMDL

1991-10-07	TABLE 8.1.1	HATCH ASSOCIATES	PEQCMALG.WK1 PEQCMALG.ALL	REV. # 3

TABLE 8.1.2 : ALGOMA STEEL
COKEMAKING - APPLIED BAT 1 COSTING

FACILITY DESCRIPTION	EST.CAP.COST $MM	ESTIMATE TYPE
Wastewater handling upstream of treatment		
Equilization Tank	2.30	C
Spare ammonia still + pumps	8.68	B
Upgrade of existing still for Caustic addition	0.46	C
Aeration basin + aerators	2.42	C
Treatment		
Primary Clarifier	1.76	C
Secondary Clarifier	1.76	C
Thickener	0.29	C
Blowdown Treatment Plant	3.29	A
Breeze basin Pumps	0.14	C
Interconnecting services	0.33	B
Allowance for rerouting stormwater	1.00	D.
TOTAL	22.43	

TABLE 8.1.3 : MISA MODEL / APPLIED BAT COSTING				
Mill :	ALGOMA STEEL			
Subcategory :	Cokemaking			
BAT :	Applied BAT #1 (Best in Ontario)			
Process Flow :	2749 m3/day			
Date:	92/03/10		Filename:	ALCMCOST.WK1
1. Capital Costs				
(a) Engineering and Design				$1,564,000
(b) Equipment				$5,035,000
(c) Installation				$5,404,000
(d) Facilities and Structure				$4,277,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$6,147,000
Total Capital Cost				$22,427,000
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements power	kWh	1838000	$0.05	$92,000
steam	tonne	5800	$15.00	$87,000
Total Energy Requirements				$179,000
(b) Materials nutrients				$64,000
polymer				$239,000
NaOH	kg	273000	$0.485	$132,000
H2SO4	kg	36400	$0.122	$4,000
chlorine	kg	91000	$0.375	$34,000
Total Materials				$473,000
(c) Operating Labour	manyears	4	$60,000	$240,000
(d) Maintenance	% of Capital	5.0%		$1,121,000
Total Operating and Maintenance				$2,013,000
4. Disposal of Sludges or Solid Wastes Increase over current operation.				
(a) Quantities Generated per Unit Time		12.0	tonne/year	$2,400
(b) Disposal Cost per Unit		$200	$/tonne	

Comments:

Sludge weight indicated on wet basis assuming 40% solids.

Bioplant solids are disposed of on the coal pile and are not included.

TABLE 8.1.4 : ALGOMA STEEL
COKEMAKING - APPLIED BAT 2 COSTING

FACILITY DESCRIPTION	EST.CAP.COST $MM	ESTIMATE TYPE
Wastewater handling upstream of treatment		
Equilization Tank	2.41	C
Spare ammonia still + pumps	9.25	B
Upgrade of existing still for Caustic addition	0.46	C
Aeration basin + aerators	2.52	C
Treatment		
Primary Clarifier	1.76	C
Secondary Clarifier	1.76	C
Thickener	0.29	C
Breeze basin Pumps	0.14	C
Interconnecting services	0.33	B
Allowance for rerouting stormwater	1.00	D
TOTAL	19.92	

TABLE 8.1.5 : MISA MODEL / APPLIED BAT COSTING				
Mill : ALGOMA STEEL Subcategory : Cokemaking BAT : Applied BAT #2 (Best in United States) Process Flow : 2932 m3/day Date: 92/02/20			Filename:	ALCMCOST.WK1
1. Capital Costs				
(a) Engineering and Design				$1,389,000
(b) Equipment				$4,487,000
(c) Installation				$4,811,000
(d) Facilities and Structure				$3,767,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$5,458,000
Total Capital Cost				**$19,912,000**
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements power	kWh	907000	$0.05	$45,000
steam	tonne	6100	$15.00	$92,000
Total Energy Requirements				$137,000
(b) Materials nutrients				$68,000
polymer				$255,000
NaOH	kg	291000	$0.485	$141,000
H2SO4	kg	39000	$0.122	$5,000
chlorine	kg	97000	$0.375	$36,000
Total Materials				$505,000
(c) Operating Labour	manyears	4	$60,000	$240,000
(d) Maintenance	% of Capital	5.0%		$996,000
Total Operating and Maintenance				**$1,878,000**
4. Disposal of Sludges or Solid Wastes		Bioplant solids to coal pile.		
(a) Quantities Generated per Unit Time			tonne/year	No increase
(b) Disposal Cost per Unit			$/tonne	
Comments:				

8.2 Ironmaking

8.2.1 BAT #1 Best in Ontario

Currently at Algoma, the gas from the blast furnaces is scrubbed with water in venturi scrubbers. The dirty water is directed to the No. 2 thickener where polymer is added to improve settling. The overflow from the thickener is directed to the Bar and Strip Lagoon then discharged. There is no recirculation on this system.

In order to achieve BAT #1 effluent quality, recycle pumps, a cooling tower and return line must be installed to permit recycle of the thickener overflow back to the venturi scrubbers. This recycled water can also be used to replace other sources of wastewater in the system such as the gas seal water. A backup thickener should be installed to serve as backup for both the ironmaking and steelmaking wastewater treatment systems.

The blowdown from the ironmaking wastewater treatment system may be directed to the slag pits for slag cooling or to a combined cokemaking and ironmaking "Blowdown" Treatment Plant. The blowdown treatment should include equalization, metals precipitation, chlorination and filtration prior to discharge. A recirculation system may be required for the slag pits to reduce or eliminate discharges. The modified wastewater treatment system is shown in Figure 8.2.1 *Algoma Steel Ironmaking Applied BAT #1 Best in Ontario.*

The predicted effluent quality data sheet, Table 8.2.1, for the modified treatment system is attached. The capital and operating cost data for this treatment technology are shown in Tables 8.2.2 and 8.2.3.

The MOE has taken the position that the use of ironmaking blowdown for slag quenching is not acceptable. The Applied BAT #1 costs adequately cover this situation which would involve a small increase in recycle rate.

8.2.2 BAT #2 Best in the United States

To upgrade Algoma's treatment system to either the BAT #2A or BAT #2B treatment system, the thickener overflow must be cooled and recycled to the venturi scrubbers and the gas seals. Installation of a cooling tower with the associated pumping and piping is required. For the BAT #2A treatment system a reactor clarifier must be installed to treat the system blowdown for suspended solids and metals removal prior to discharge. To apply the BAT #2B treatment system at Algoma a recirculation system is required for slag quenching water to reduce or eliminate discharges. Blowdown from the ironmaking recycle system can be reused as makeup water for slag quenching. These treatment system modifications are shown in Figure 8.2.2 *Algoma Steel Ironmaking Applied BAT #2 Best in the United States*.

The predicted effluent quality data sheet, Table 8.2.1, is attached. The capital and operating cost data for this treatment technology are shown in Tables 8.2.4 and 8.2.5. For costing purposes, BAT #2A has been estimated.

8.2.3 BAT #3 Best at Selected World Locations

The best available Ironmaking wastewater treatment technology was determined to be the BAT #1 process. The BAT #1 treatment system is described in section 8.2.1.

8.2.4 BAT #4 Non-Lethal

The BAT #3 wastewater treatment technology for Ironmaking was determined to be the BAT#1 process. The applied BAT #1 modifications are outlined in section 8.2.1.

There is no specific toxicity data available for the treated ironmaking wastewater effluent stream. The effluent is marginal to pass the Ontario Toxicity Test because of ammonia and cyanide levels. However, these levels are very low and toxicity will be dependent on temperature and pH.

The technology demonstrated at Stelco LEW where the treated effluent from the ironmaking is further co-treated with other process streams through a chemical/physical blowdown treatment

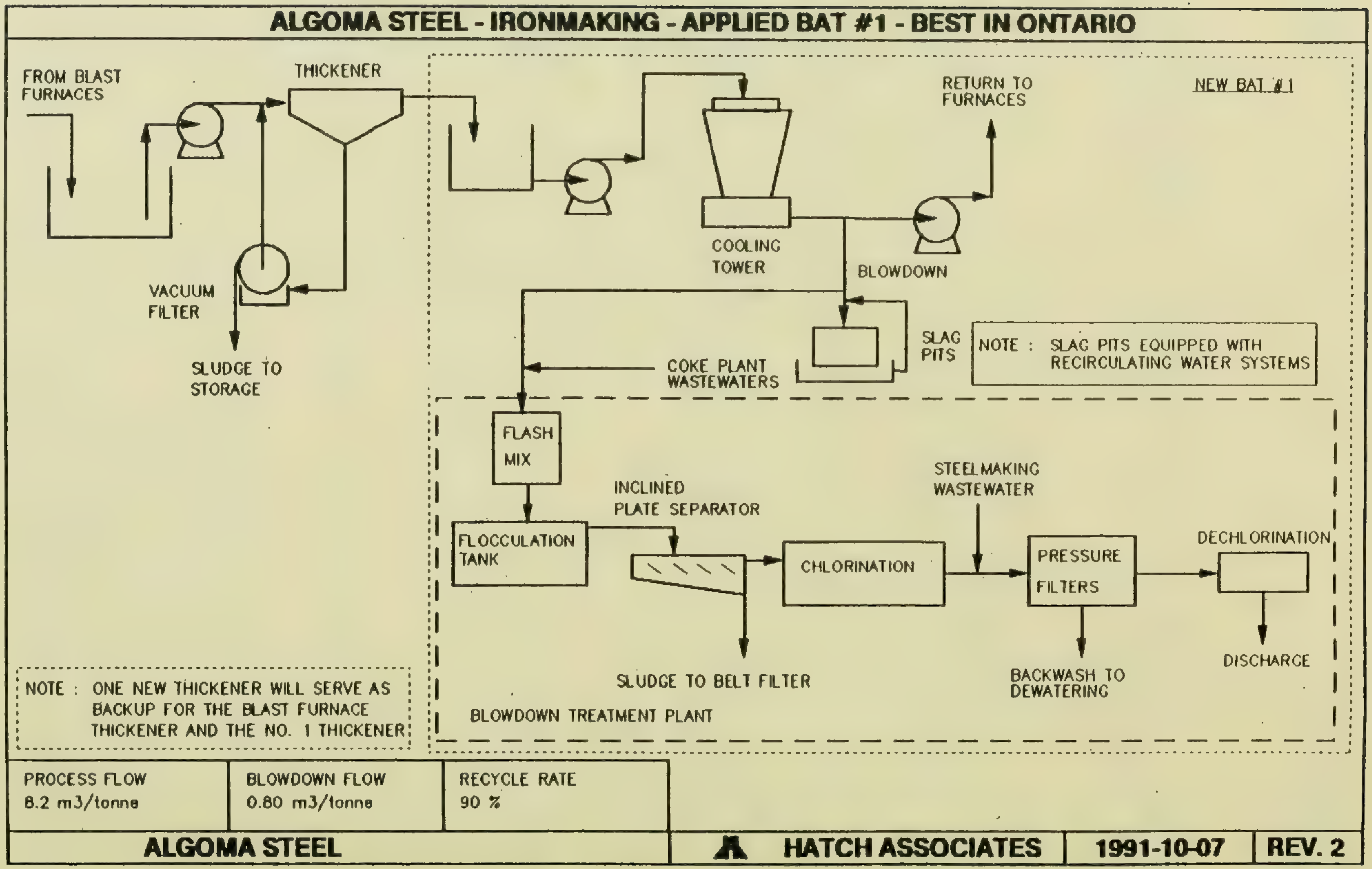
facility was found to be non-lethal most of the time for the total mill effluent. At Algoma it is likely that ironmaking effluent will also be co-treated and combined with other wastewaters prior to discharge to the receiving waters.

8.2.5 BAT #5 Virtual Elimination of Persistent Toxics

The BAT #3 wastewater treatment technology for Ironmaking was determined to be the BAT#1 process. The applied BAT #1 modifications are outlined in section 8.2.1.

This wastewater stream from BAT #1 is expected to contain very low levels (in some cases below the RMDL) of organic compounds. No demonstrated technologies are known to further reduce the concentrations of these compounds to lower levels. Virtual elimination of persistent toxics can only be assured by zero discharge. No discharge to receiving water may be achieved with further treatment by ultrafiltration and ion exchange, or evaporation which may permit the treated water to be recycled to the process. However, these treatment technologies are not demonstrated in this industrial sector.

As outlined in Section 8.2.4 above, it is unlikely that ironmaking wastewater would be discharged directly. It is likely that the effluent will be co-treated with other streams prior to discharge. No assessment can be made of this combined stream without appropriate data.



ALGOMA STEEL - IRONMAKING - APPLIED BAT #1 - BEST IN ONTARIO
FROM BLAST FURNACES
THICKENER
VACUUM FILTER
SLUDGE TO STORAGE
NEW BAT #1
COOLING TOWER
RETURN TO FURNACES
BLOWDOWN
SLAG PITS
NOTE : SLAG PITS EQUIPPED WITH RECIRCULATING WATER SYSTEMS
COKE PLANT WASTEWATERS
FLASH MIX
FLOCCULATION TANK
INCLINED PLATE SEPARATOR
CHLORINATION
STEELMAKING WASTEWATER
PRESSURE FILTERS
DECHLORINATION
SLUDGE TO BELT FILTER
BACKWASH TO DEWATERING
DISCHARGE
BLOWDOWN TREATMENT PLANT
NOTE : ONE NEW THICKENER WILL SERVE AS BACKUP FOR THE BLAST FURNACE THICKENER AND THE NO. 1 THICKENER
PROCESS FLOW 8.2 m3/tonne
BLOWDOWN FLOW 0.80 m3/tonne
RECYCLE RATE 90 %
ALGOMA STEEL
HATCH ASSOCIATES
1991-10-07
REV. 2

FIGURE 8.2.1

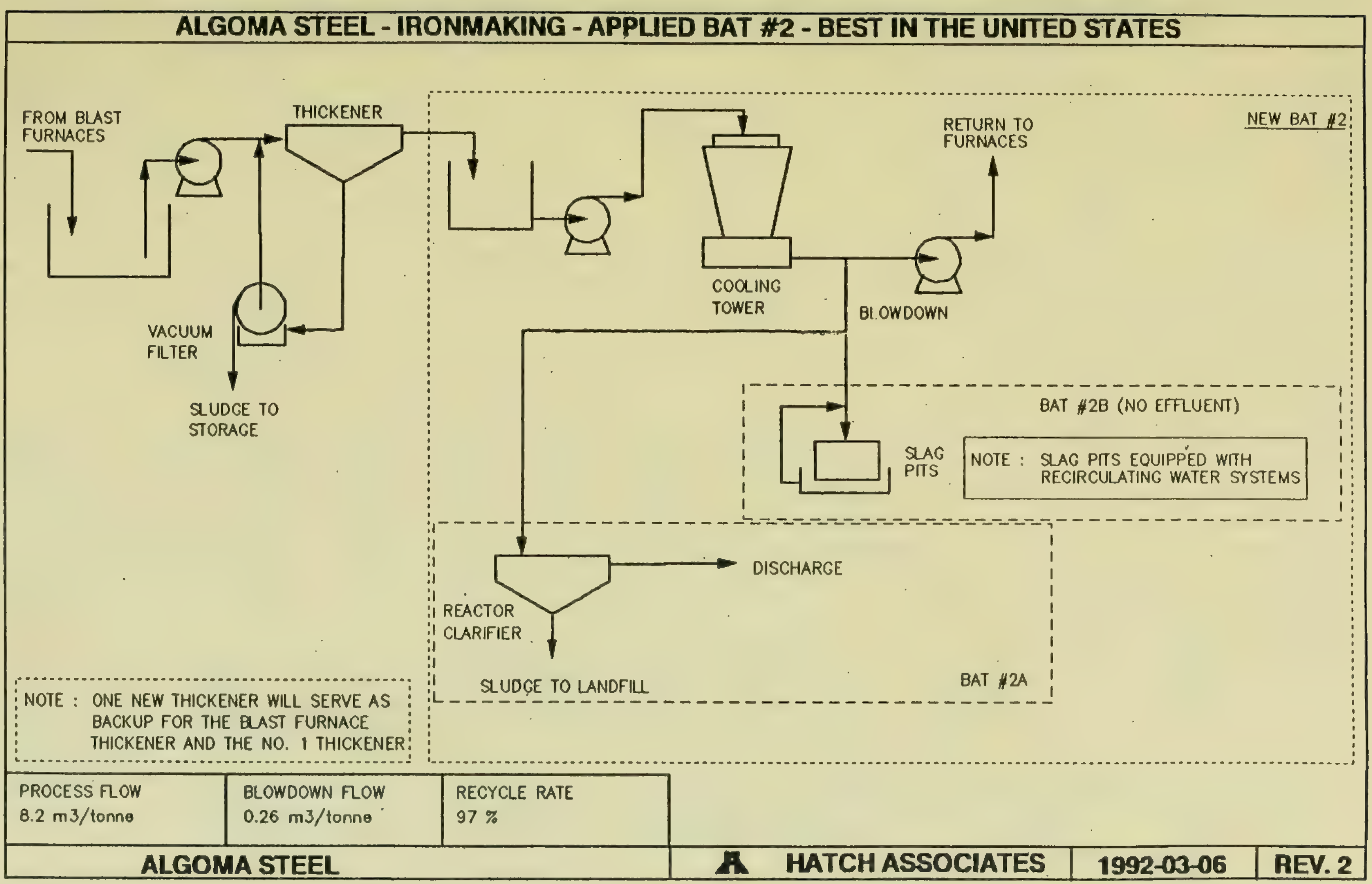

ALGOMA STEEL - IRONMAKING - APPLIED BAT #2 - BEST IN THE UNITED STATES
FROM BLAST FURNACES
THICKENER
VACUUM FILTER
SLUDGE TO STORAGE
NEW BAT #2
COOLING TOWER
RETURN TO FURNACES
BLOWDOWN
BAT #2B (NO EFFLUENT)
SLAG PITS
NOTE : SLAG PITS EQUIPPED WITH RECIRCULATING WATER SYSTEMS
DISCHARGE
REACTOR CLARIFIER
SLUDGE TO LANDFILL
BAT #2A
NOTE : ONE NEW THICKENER WILL SERVE AS BACKUP FOR THE BLAST FURNACE THICKENER AND THE NO. 1 THICKENER
PROCESS FLOW 8.2 m3/tonne
BLOWDOWN FLOW 0.26 m3/tonne
RECYCLE RATE 97 %
ALGOMA STEEL
HATCH ASSOCIATES
1992-03-06
REV. 2

FIGURE 8.2.2

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – IRONMAKING – ALGOMA

BAT	EXISTING (Note 1)		BAT #1		BAT #2A		BAT #2B	BAT #3	BAT #4	BAT #5
Flow (m3/day)	51351		4988		1621					
Parameter	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)				
TSS	33	1734	* 4.9	24	8.6	14	No effluent to receiving water – slag evaporation.	See BAT #1.	See BAT #1.	No demonstrated technology in this industry sector.
oil and grease	* 0.85	45	-	-	-	-				
ammonia + ammonium	2.4	122	0.52	2.6	62	100				
cyanide total	1.7	88	0.47	2.3	0.14	0.22				
phenolics (4AAP)	0.061	3.0	0.012	0.061	0.083	0.14				
lead	0.14	7.1	* 0.022	0.11	0.019	0.031				
zinc	0.79	41	0.045	0.22	0.20	0.32				

Notes: 1. Direct from MISA Monitoring Point, MIDES #1300.

* less than RMDL

1992-02-12	TABLE 8.2.1	HATCH ASSOCIATES	PEQIRALG.WK1 PEQIRALG.ALL	REV. # 4

TABLE 8.2.2 : ALGOMA STEEL
IRONMAKING - APPLIED BAT 1 COSTING

FACILITY DESCRIPTION	EST.CAP.COST $MM	ESTIMATE TYPE
Backup thickener shared between Iron making and steelmaking	4.27	C
Cooling tower + basins + pumps	6.92	C
Piping between thickener + cooling tower	1.18	B
Piping to BF #7 + #6	0.58	B
Blowdown Treatment Plant	8.95	A
TOTAL	21.90	

TABLE 8.2.3 : MISA MODEL / APPLIED BAT COSTING				
Mill : ALGOMA STEEL Subcategory : Ironmaking BAT : Applied BAT #1 (Best in Ontario) Process Flow : 7152 m3/day Date: 92/03/10			Filename:	ALSICOST.WK1
1. Capital Costs				
(a) Engineering and Design				$1,526,000
(b) Equipment				$4,963,000
(c) Installation				$5,314,000
(d) Facilities and Structure				$4,080,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$5,998,000
Total Capital Cost				**$21,881,000**
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements power	kWh	13789000	$0.05	$689,000
Total Energy Requirements				$689,000
(b) Materials NaOH	kg	710200	$0.485	$344,000
H2SO4	kg	94700	$0.122	$12,000
chlorine	kg	236800	$0.375	$89,000
polymer				$620,000
Total Materials				$1,065,000
(c) Operating Labour	manyears	6	$60,000	$360,000
(d) Maintenance	% of Capital	5.0%		$1,094,000
Total Operating & Maintenance				**$3,208,000**
4. Disposal of Sludges or Solid Wastes Increase over current operation.				
(a) Quantities Generated per Unit Time		1560	tonne/year	$312,000
(b) Disposal Cost per Unit		$200	$/tonne	
Comments:				

TABLE 8.2.4 : ALGOMA STEEL
IRONMAKING - APPLIED BAT 2 COSTING

FACILITY DESCRIPTION	EST.CAP.COST $MM	ESTIMATE TYPE
Backup thickener shared between Iron making and steelmaking	4.27	C
Cooling tower + basins + pumps	6.92	C
Piping between thickener + cooling tower	1.18	B
Piping to BF #7 + #6	0.58	B
Blowdown Treatment Plant		
Reactor clarifier	1.21	C
Miscellaneous equipment	0.46	C
Pumps	0.04	C
Inter-connecting piping etc.	0.76	B
TOTAL	15.42	

TABLE 8.2.5 : MISA MODEL / APPLIED BAT COSTING				
Mill : ALGOMA STEEL Subcategory : Ironmaking BAT : Applied BAT #2A (Best in United States) Process Flow : 1520 m3/day Date: 92/03/10 Filename: ALSICOST.WK1				
1. Capital Costs				
(a) Engineering and Design				$1,075,000
(b) Equipment				$3,635,000
(c) Installation				$3,861,000
(d) Facilities and Structure				$2,613,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$4,224,000
Total Capital Cost				$15,408,000
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements power	kWh	11963000	$0.05	$598,000
Total Energy Requirements				$598,000
(b) Materials polymer				$132,000
NaOH	kg	151000	$0.485	$73,000
H2SO4	kg	20100	$0.122	$2,000
chlorine	kg	50300	$0.375	$19,000
Total Materials				$226,000
(c) Operating Labour	manyears	4	$60,000	$240,000
(d) Maintenance	% of Capital	5.0%		$770,000
Total Operating & Maintenance				$1,834,000
4. Disposal of Sludges or Solid Wastes Increase over current operation.				
(a) Quantities Generated per Unit Time		1580	tonne/year	$316,000
(b) Disposal Cost per Unit		$200	$/tonne	
Comments:				

8.3 Steelmaking

8.3.1 General

Both of the wet gas cleaning BOSP shops at Algoma are open combustion systems. Currently the off-gas from the furnaces is cooled and scrubbed using water on a once through basis. The dirty water is directed to the No. 1 thickener for solids removal then to the Bar and Strip Lagoon prior to discharge to the St. Mary's River.

As outlined in the Model BATs, the BAT #1 selection for open combustion is Stelco Hilton dry gas cleaning system. However, retrofit of a dry gas cleaning system would be a major and expensive undertaking, and is considered unreasonable when compared with the very low discharge attainable by recycle systems followed by blowdown treatment, at much lower cost. The BAT #1 selected for suppressed combustion is a typical recycle system which is applicable both to suppressed and open combustion systems. A BAT #1 for wet gas cleaning in open combustion systems could not be selected due to lack of data on the systems at Dofasco and Algoma. However, current practice in the industry is to recycle gas cleaning water after settleable solids removal in a thickener.

8.3.2 BAT #1 Best in Ontario

From the above description, it will be seen that a direct comparison with performance data for Algoma's wet gas cleaning system is not available. However, a reasonable assessment would require upgrading of the present once through system to a recycle system with a cooling tower. Recycle has been conservatively estimated at the same blowdown flow as Stelco LEW, or about 50% based on Algoma's MISA flow rates.

As recycle is implemented, lead and zinc levels are expected to increase, necessitating treatment of the system blowdown. Treatment may be possible in the Main Filter Plant depending on the actual metals levels in the wastewater. (The primary requirement is for suspended solids removal). The treated wastewater from the Main Filter Plant may also be recycled for reuse within the plant in future. For these reasons a blowdown treatment plant to achieve metals

removal and solids removal by filtration has been allowed for in the cost estimates, although it is recognized that this may eventually prove to be overly conservative. A backup thickener is required to service both the ironmaking and steelmaking wastewater systems. The modified treatment system is shown in Figure 8.3.1 *Algoma Steelmaking Applied BAT #1 Best in Ontario*.

The predicted effluent quality data sheet, Table 8.3.1, for the modified treatment system is attached. The capital and operating cost data for this treatment technology are shown in Tables 8.3.2 and 8.3.3.

8.3.3 <u>BAT #2 Best in The U.S.A.</u>

It was possible to identify a "sister" mill with available data to compare with Algoma and Dofasco. This is Inland Steel, Indiana Harbour No. 4 BOF.

To implement a similar system at Algoma a recycle system complete with pumps, pipework, cooling tower and all associated equipment is required. A higher rate of recycle is practised, thus significantly reducing the blowdown flow. The blowdown flow from the system is treated by Ph adjustment and pressure sand filtration prior to discharge. It may be possible to utilise the Main Filter Plant for this treatment subject to the reservations outlined in BAT #1 above. However, at this time the cost estimates have provided for a new filtration plant and associated works. This may prove to be overly conservative, depending on the exact effluent quality experienced after this level of recycle is achieved. The treatment system is shown in Figure 8.3.2 *Algoma Steelmaking Applied BAT #2 Best in the United States*.

The capital and operating cost data for this treatment technology are given in Tables 8.3.4 and 8.3.5.

8.3.4 BAT #3 Best at Selected World Locations

The BAT #2B Steelmaking wastewater treatment system was determined to be the best available process. The applied BAT #2B modifications are described in section 8.3.3. As discussed in BAT #1, retrofit of dry gas cleaning is not considered reasonable since very low emission levels can be accomplished with a high rate recycle system as outlined for BAT #2. This is reviewed in more detail for Dofasco in Section 10.3.3.

8.3.5 BAT #4 Non Lethal

The BAT #3 wastewater treatment technology was determined to be BAT #2. A review of the effluent quality from the BAT #2 technology would indicate that the effluent is probably not toxic depending on hardness and dissolved solids in the wastewater. The zinc level is above the LC50 but the effluent is likely to be high in carbonate alkalinity.

Steelmaking wastewater is likely to be discharged with ironmaking blowdown and cokemaking wastewater after treatment in the blowdown treatment plant. The final discharge point and the other streams likely to be combined with these streams are not known at this time. Therefore, no reliable toxicity assessment can be made.

8.3.6 BAT #5 Virtual Elimination of Persistent Toxics

The Best Available Technology #3 for Steelmaking wet gas cleaning wastewater was determined to be the BAT #2 treatment process. These technologies are detailed in Section 8.3.3.

The Steelmaking wastewater stream is not expected to contain any persistent bioaccumulative toxics, however, the stream is expected to contain low levels of lead and zinc. No demonstrated technologies are known to further reduce the concentrations of these compounds. Virtual elimination of persistent toxics can only be assured by zero discharge. This may be achieved with further treatment by ultrafiltration and ion exchange, or evaporation which may permit the treated water to be recycled to the process. However, these treatment technologies are not demonstrated in this industrial sector.

The steelmaking wastewater at Algoma is likely to be combined with other streams prior to discharge. These will be ironmaking and cokemaking wastewaters if a common treatment plant is used. However, other streams may be combined prior to discharge. This may result in a combined stream in which all contaminants are below RMDL, in which case virtual elimination may be deemed to have been met. In the absence of specific information no assessment can be made. An alternative technology to achieve BAT #5 Virtual Elimination is dry gas cleaning as established at Stelco Hilton Works.

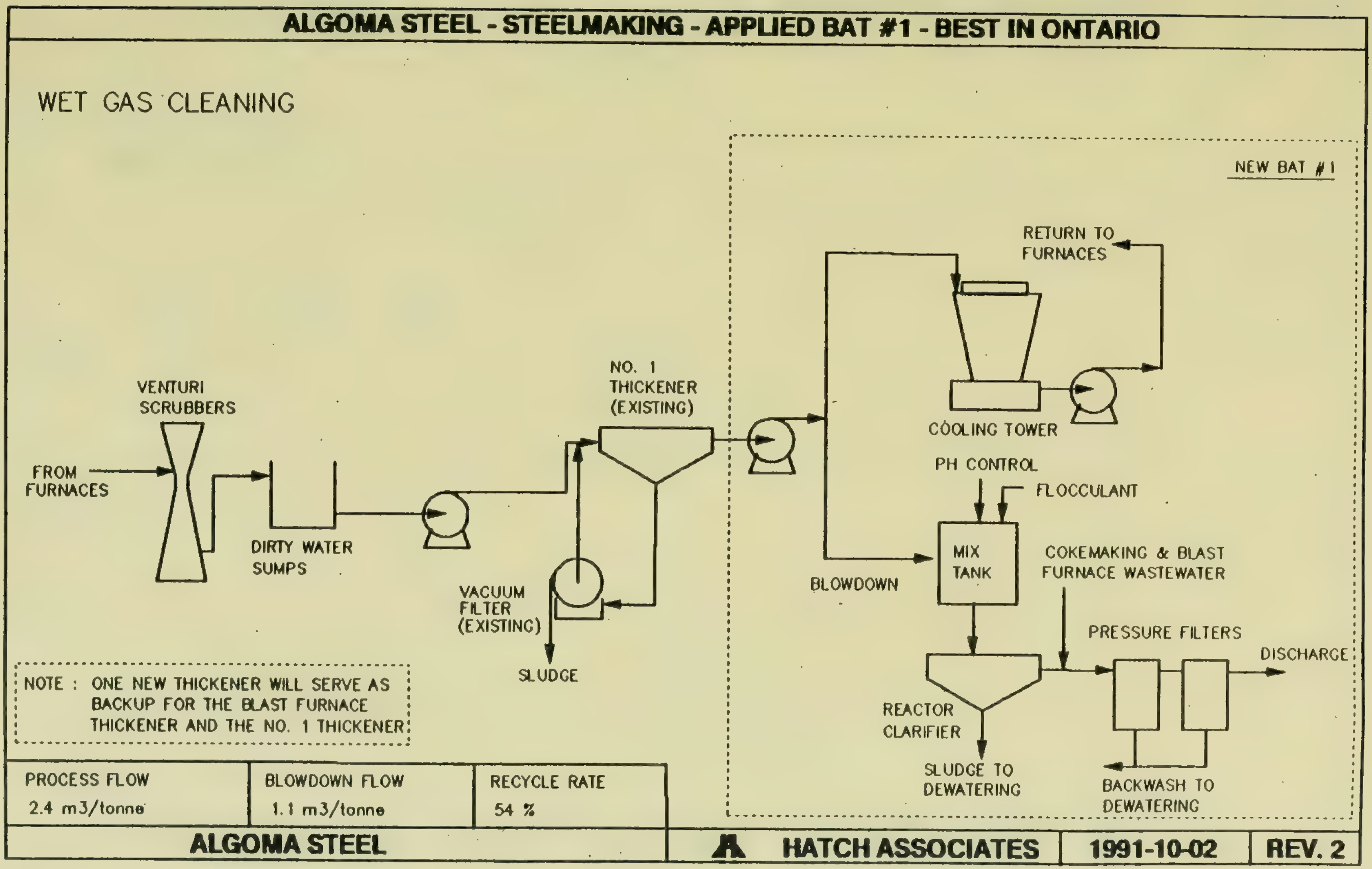
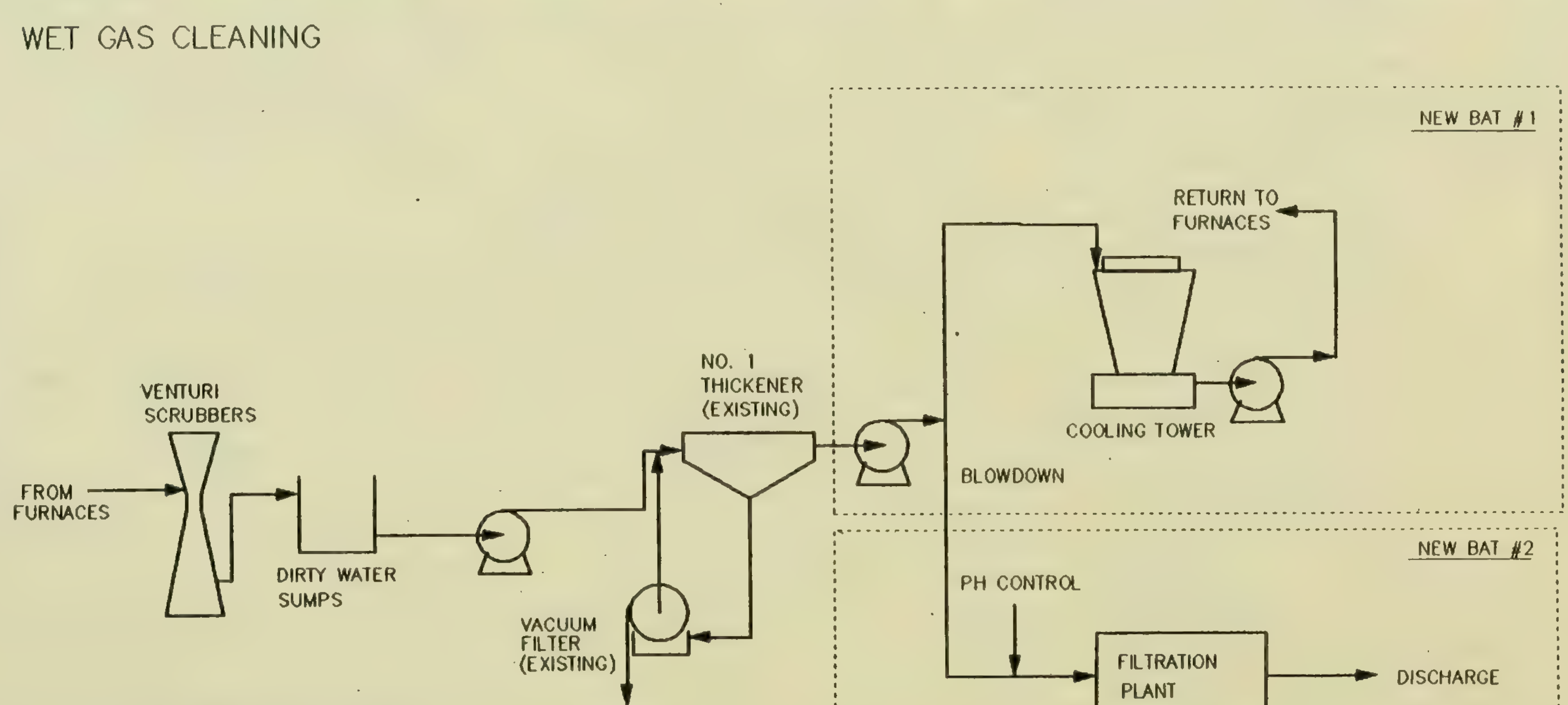

ALGOMA STEEL - STEELMAKING - APPLIED BAT #1 - BEST IN ONTARIO
WET GAS CLEANING
NEW BAT #1
FROM FURNACES
VENTURI SCRUBBERS
DIRTY WATER SUMPS
NO. 1 THICKENER (EXISTING)
VACUUM FILTER (EXISTING)
SLUDGE
RETURN TO FURNACES
COOLING TOWER
PH CONTROL
FLOCCULANT
BLOWDOWN
MIX TANK
COKEMAKING & BLAST FURNACE WASTEWATER
PRESSURE FILTERS
DISCHARGE
REACTOR CLARIFIER
SLUDGE TO DEWATERING
BACKWASH TO DEWATERING
NOTE : ONE NEW THICKENER WILL SERVE AS BACKUP FOR THE BLAST FURNACE THICKENER AND THE NO. 1 THICKENER
PROCESS FLOW
2.4 m3/tonne
BLOWDOWN FLOW
1.1 m3/tonne
RECYCLE RATE
54 %
ALGOMA STEEL
HATCH ASSOCIATES
1991-10-02
REV. 2

FIGURE 8.3.1

ALGOMA STEEL - STEELMAKING - APPLIED BAT #2 - BEST IN THE UNITED STATES



NOTE : ONE NEW THICKENER WILL SERVE AS BACKUP FOR THE BLAST FURNACE THICKENER AND THE NO. 1 THICKENER

PROCESS FLOW	BLOWDOWN FLOW	RECYCLE RATE
2.4 m3/tonne	0.24 m3/tonne	90 %

ALGOMA STEEL	HATCH ASSOCIATES	1992-02-20	REV. 3

FIGURE 8.3.2

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – STEELMAKING – ALGOMA

BAT	EXISTING (Note 1)		BAT #1		BAT #2B (Note 2)		BAT #3A	BAT #3B	BAT #4	BAT #5
Flow (m3/day)	15117		7010		1530					
Parameter	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)				
TSS	79	1075	* 4.9	35	3.0	4.6	Wet Gas Cleaning, BAT #2B.	Dry Gas Cleaning, no effluent.	BAT #2B or Dry Gas Cleaning.	No demonstrated wet technology; or Dry Gas Cleaning.
oil and grease	* 0.86	13	–	–	–	–				
lead	* 0.025	0.37	0.093	0.70	0.059	0.089				
zinc	0.037	0.52	0.19	1.3	0.12	0.17				

Notes: 1. Direct data from MISA MIDES #1200, #1 THICKENER.

2. Algoma's No. 1 and No. 2 Melt Shops are open combustion systems with wet gas cleaning.

* less than RMDL

1992–02–12	TABLE 8.3.1	HATCH ASSOCIATES	PEQSMALG.WK1 PEQSMALG.ALL	REV. # 4

TABLE 8.3.2 : ALGOMA STEEL
STEELMAKING - APPLIED BAT 1 COSTING

FACILITY DESCRIPTION		EST.CAP.COST $MM	ESTIMATE TYPE
Cooling tower + basins + pumps		0.93	C
Inter-connecting Piping		0.89	B
Thickener		2.30	C
Reactor Clarifier + Filtration Plant		12.72	A
	TOTAL	16.84	

TABLE 8.3.3 : MISA MODEL / APPLIED BAT COSTING

Mill :	ALGOMA STEEL			
Subcategory :	STEELMAKING			
BAT :	Applied BAT #1 (Best in Ontario)			
Process Flow :	22085 m3/day (BLOWDOWN = 10242 m3/day)			
Date:	92/03/10		Filename:	ALSLCOST.WK1
1. Capital Costs				
(a) Engineering and Design				$1,175,000
(b) Equipment				$3,769,000
(c) Installation				$4,048,000
(d) Facilities and Structure				$3,234,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$4,616,000
Total Capital Cost				$16,842,000
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements power	kWh	6568000	$0.05	$328,000
Total Energy Requirements				$328,000
(b) Materials NaOH	kg	1017000	$0.485	$493,000
H2SO4	kg	136000	$0.122	$17,000
chemical	kg	339000	$0.375	$127,000
polymer				$889,000
Total Materials				$1,526,000
(c) Operating Labour	manyears	4	$60,000	$240,000
(d) Maintenance	% of Capital	5.0%		$842,000
Total Operating & Maintenance				$2,936,000
4. Disposal of Sludges or Solid Wastes Increase over current operation.				
(a) Quantities Generated per Unit Time		1560	tonne/year	$312,000
(b) Disposal Cost per Unit		$200	$/tonne	
Comments:				

TABLE 8.3.4 : ALGOMA STEEL
STEELMAKING - APPLIED BAT 2B COSTING

FACILITY DESCRIPTION	EST.CAP.COST $MM	ESTIMATE TYPE
Cooling tower + basins + pumps	1.48	C
Inter-connecting Piping	1.22	B
Thickener	2.03	C
Filtration Plant	1.50	A
TOTAL	6.23	

TABLE 8.3.5 : MISA MODEL / APPLIED BAT COSTING

Mill : ALGOMA STEEL
Subcategory : STEELMAKING
BAT : Applied BAT #2B (Best in United States)
Process Flow : 22085 m3/day (BLOWDOWN = 1580 m3/day)
Date: 92/03/10 Filename: ALSLCOST.WK1

1. Capital Costs				
(a) Engineering and Design				$434,000
(b) Equipment				$1,492,000
(c) Installation				$1,580,000
(d) Facilities and Structure				$1,016,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$1,708,000
Total Capital Cost				**$6,230,000**
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements power	kWh	9835000	$0.05	$492,000
Total Energy Requirements				$492,000
(b) Materials polymer				$137,000
NaOH	kg	157000	$0.485	$76,000
H2SO4	kg	21000	$0.122	$3,000
chemical	kg	53000	$0.375	$20,000
Total Materials				$236,000
(c) Operating Labour	manyears	4	$60,000	$240,000
(d) Maintenance	% of Capital	5.0%		$312,000
Total Operating & Maintenance				**$1,280,000**
4. Disposal of Sludges or Solid Wastes Increase over current operation.				
(a) Quantities Generated per Unit Time		980	tonne/year	$196,000
(b) Disposal Cost per Unit		$200	$/tonne	

Comments:

8.4 Continuous Casting and Hot Forming

8.4.1 BAT #1 Best in Ontario

Currently at Algoma, water is used as once through contact cooling water at the No. 1 caster, the No. 2 caster and the primary, flat and section mills. The water from these systems, except the No. 1 caster, flows to scale pits then to the Main Filter Plant prior to discharge to the Terminal Lagoon. The No. 1 caster cooling water flows to the Bar and Strip Lagoon.

To achieve a BAT #1 level of effluent quality, a cooling tower and a recirculation system may be installed to recycle the water from the Main Filter Plant back to these systems. In order to implement this system, the No. 1 caster effluent should be redirected from the Bar and Strip Lagoon to the Main Filter Plant and the Finishing wastewater should not be discharged to the Main Filter Plant. The Finishing wastewater stream should be treated separately and discharged to either Davignon Creek or the Terminal Lagoon. Methods to control emergency overflows from the sanitary wastewater systems to the hot forming system should also be evaluated. This treatment system is shown in Figure 8.4.1 *Algoma Steel Continuous Casting & Hot Forming Applied BAT #1 Best in Ontario*.

The predicted effluent quality data sheets, Tables 8.4.1 and 8.4.2, for the modified treatment system are attached. The capital and operating cost data for this treatment technology are given in Tables 8.4.3 and 8.4.4.

8.4.2 BAT #2 Best in the United States

The BAT #2 wastewater treatment modifications are the same as the BAT #1 modifications with the blowdown flows reduced to 0.076 m^3/tonne from the No. 1 and No. 2 caster systems and 0.36 m^3/tonne from the hot forming system. There is a small blowdown flow from steelmaking sent to the caster system. The treatment system is shown in Figure 8.4.1.

The capital and operating costs data for BAT #2 are given on Tables 8.4.5 and 8.4.6.

8.4.3 BAT #3 Best at Selected World Locations

The best available treatment system for the Continuous Casting and Hot Forming wastewater was determined to be the BAT #2 technology. The modifications required to achieve a BAT #2 level of effluent quality are detailed in section 8.4.2.

8.4.4 BAT #4 Non-Lethal

The BAT #3 wastewater treatment technology for Continuous Casting and Hot Forming was determined to be the BAT #2 process. The applied BAT #2 modifications are outlined in section 8.4.2.

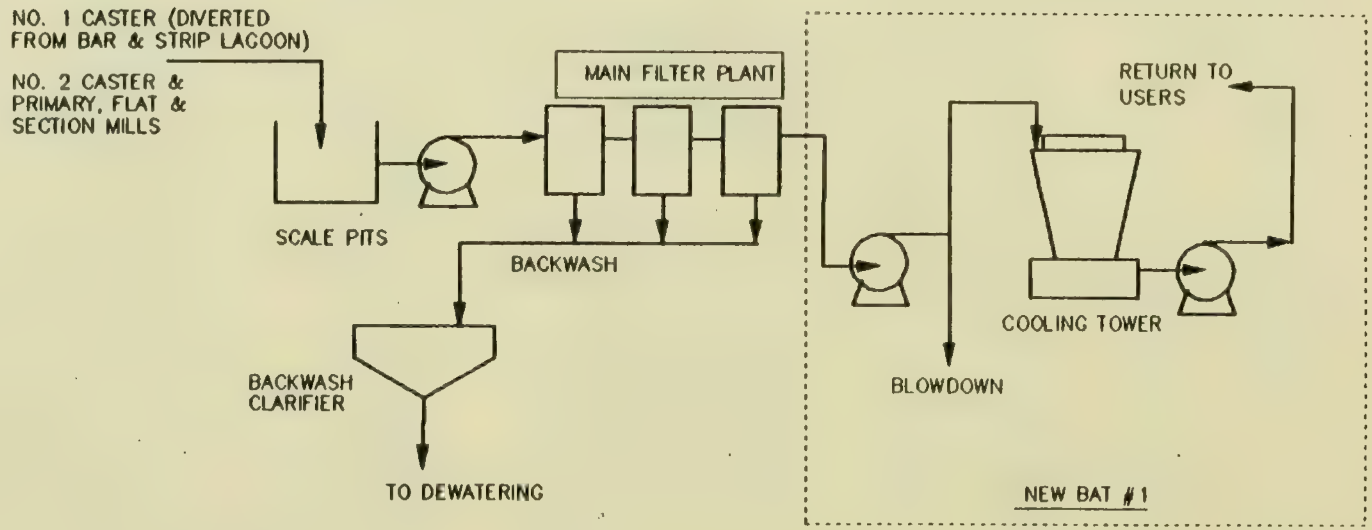
There is no specific toxicity data available for the co-treated Continuous Casting and Hot Forming wastewater stream. However, based on a review of predicted effluent concentrations, low levels of lead and zinc will be present in the Continuous Casting wastewater. Based on testing of the Hot Forming Wastewater, the Hot Forming effluent is expected to pass the Ontario Toxicity Test. Since the majority of the wastewater is Hot Forming effluent, the co-treated stream will contain extremely low levels of lead and zinc and will probably pass the Ontario Toxicity Test.

8.4.5 BAT #5 Virtual Elimination of Persistent Toxics

The BAT #3 wastewater treatment technology for Continuous Casting and Hot Forming was determined to be the BAT #2 process. The applied BAT #2 modifications are outlined in Section 8.4.2.

As discussed in Section 8.4.4 above, low levels of lead and zinc are present in the Continuous Casting effluent. The lead and zinc concentrations will be reduced to extremely low levels in the co-treated Continuous Casting and Hot Forming effluent. This effluent is likely to meet virtual elimination of persistent toxics.

ALGOMA STEEL - CONTINUOUS CASTING & HOT FORMING - APPLIED BAT #1 - BEST IN ONTARIO



	NO.1 & NO.2 CASTERS	PRIMARY,FLAT & SECTION MILLS
BLOWDOWN FLOWS	1.4 m3/tonne	0.85 m3/tonne
PROCESS FLOWS	7.6 m3/tonne	41.6 m3/tonne

ALGOMA STEEL | HATCH ASSOCIATES | 1991-10-07 | REV. 1

FIGURE 8.4.1

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – CONTINUOUS CASTING – ALGOMA

BAT	EXISTING		BAT #1		BAT #2		BAT #3	BAT #4	BAT #5
Flow (m3/day)			7564		411				
Parameter	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)			
TSS	No data available.		* 4.9	36	21	7.6	See BAT #2.	See BAT #2.	No demonstrated technology in this industry sector.
oil and grease			1.4	11	1.8	0.86			
lead			–	–	0.13	0.047			
zinc			–	–	0.11	0.043			

* less than RMDL

1991–10–07	TABLE 8.4.1	HATCH ASSOCIATES	PEQCCALG.WK1 PEQCCALG.ALL	REV. # 3

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – HOT FORMING – ALGOMA–MAIN FILTER PLANT

BAT	EXISTING (Note 1)		BAT #1 (Note 2)		BAT #2 (Note 2)		BAT #3	BAT #4	BAT #5
Flow (m3/day)	347065		6228		2638				
Parameter	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)			
TSS	* 1.9	671	* 4.9	31	2.9	8.1	See BAT #2.	See BAT #2 (Note 3).	Not applicable.
oil and grease	* 0.90	311	6.2	39	7.1	17			

Notes:
1. Data direct from MISA MIDES #0700 for the period April 16 – July 31, 1990 (MAIN FILTER PLANT). A new WWTP came on line April 16, 1990. The Hot Forming effluents contributing to this outfall include the 45″ Blooming Mill, the 46″ Slabbing Mill, the Plate Mill, 106/166 Hot Strip Mill, Rail and Structural Mill. These processes represent approximately 85 – 90% of the total flow to the Main Filter Plant. The remaining flow includes No. 2 Caster effluent and Finishing wastewater.

2. Calculations based on the total Hot Forming production at Algoma excluding the No. 1 and No. 2 Tube Mills.

3. Algoma's current effluent, MIDES #0700 passed the Ontario Toxicity Test nine out of nine times.

* less than RMDL

1992-02-12	TABLE 8.4.2	HATCH ASSOCIATES	PEQHFMFP.WK1 PEQHFMFP.ALL	REV. #4

TABLE 8.4.3 : ALGOMA STEEL
CONTINUOUS CASTING + HOT FORMING - APPLIED BAT 1 COSTING

FACILITY DESCRIPTION	EST.CAP.COST $MM	ESTIMATE TYPE
Cooling tower + basins + pumps	10.13	C
Inter-connecting Piping	2.18	B
Major plant-wide water supply system modifications as per Stelco	18.3	D
TOTAL	30.61	

TABLE 8.4.4 : MISA MODEL / APPLIED BAT COSTING

Mill :	ALGOMA STEEL			
Subcategory :	CONTINUOUS CASTING + HOT FORMING			
BAT :	Applied BAT #1 (Best in Ontario)			
Process Flow :	347000 m3/day (BLOWDOWN = 15663 m3/day)			
Date:	92/03/10		Filename:	ALCCCOST.WK1

1. Capital Costs				
(a) Engineering and Design				$2,133,000
(b) Equipment				$8,920,000
(c) Installation				$9,097,000
(d) Facilities and Structure				$2,051,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$8,384,000
Total Capital Cost				$30,585,000
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements power	kWh	1.1E+08	$0.05	$5,635,000
Total Energy Requirements				$5,635,000
(b) Materials NaOH	kg		$0.485	$0
H2SO4	kg		$0.122	$0
chlorine	kg		$0.375	$0
polymer				
Total Materials				$0
(c) Operating Labour	manyears	4	$60,000	$240,000
(d) Maintenance	% of Capital	5.0%		$1,529,000
Total Operating & Maintenance				$7,404,000
4. Disposal of Sludges or Solid Wastes Increase over current operation.				
(a) Quantities Generated per Unit Time		585	tonne/year	$117,000
(b) Disposal Cost per Unit		$200	$/tonne	

Comments:

TABLE 8.4.5 : ALGOMA STEEL
CONTINUOUS CASTING + HOT FORMING - APPLIED BAT 2 COSTING

FACILITY DESCRIPTION	EST.CAP.COST $MM	ESTIMATE TYPE
Cooling tower + basins + pumps	10.26	C
Inter-connecting Piping	2.18	B
Major plant-wide water supply system modifications as per Stelco	18.3	D
TOTAL	30.74	

TABLE 8.4.6 : MISA MODEL / APPLIED BAT COSTING				
Mill : ALGOMA STEEL Subcategory : CONTINUOUS CASTING + HOT FORMING BAT : Applied BAT #2 (Best in United States) Process Flow : 22085 m3/day (BLOWDOWN = 2638 m3/day) Date: 92/03/10 Filename: ALCCCOST.WK1				
1. Capital Costs				
(a) Engineering and Design				$2,142,000
(b) Equipment				$8,948,000
(c) Installation				$9,127,000
(d) Facilities and Structure				$2,077,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$8,418,000
Total Capital Cost				$30,712,000
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements power	kWh	1.1E+08	$0.05	$5,635,000
Total Energy Requirements				$5,635,000
(b) Materials polymer				
NaOH	kg		$0.485	$0
H2SO4	kg		$0.122	$0
chlorine	kg		$0.375	$0
Total Materials				$0
(c) Operating Labour	manyears	4	$60,000	$240,000
(d) Maintenance	% of Capital	5.0%		$1,536,000
Total Operating & Maintenance				$7,411,000
4. Disposal of Sludges or Solid Wastes Increase over current operation.				
(a) Quantities Generated per Unit Time		610	tonne/year	$122,000
(b) Disposal Cost per Unit		$200	$/tonne	
Comments:				

8.5 Hot Forming - No. 1 & No. 2 Tube Mills

8.5.1 BAT #1 Best in Ontario

Currently, the wastewater from the No. 1 Tube Mill is directed to a scale settling basin, then to a lagoon prior to discharge. In order to upgrade the treatment system to the Model BAT #1 level, the process water piping and the non-contact cooling water piping should be separated. Wastewater pumping and piping and recycle pumping and piping to and from the No. 2 Tube Mill Filter Plant are required to filter and cool the No. 1 Tube Mill water for reuse. A small blowdown stream is discharged from this system. The modifications to the wastewater treatment system are shown in Figure 8.5.1 *Algoma Steel No. 1 Tube Mill Applied BAT #1 Best in Ontario*.

The No. 2 Tube Mill is a modern facility. The wastewater flows from the scale pit through pressure filters and a cooling tower. The water is then recycled back to the process. No. 2 Tube Mill Filter Plant is sized to accept the flow from the No. 1 Tube Mill, therefore, no modifications to this plant are required. The blowdown flow from this system should be reduced to 0.85 m^3/tonne to achieve the same level of treatment as Model BAT #1.

The predicted effluent quality data sheet, Table 8.5.1, for the modified treatment system is attached. The capital and operating cost data for this treatment technology are given in Tables 8.5.2 and 8.5.3.

8.5.2 BAT #2 Best in the United States

The BAT #2 wastewater treatment system is the same as BAT #1 with the blowdown flows from both the No. 1 and No. 2 Tube Mills reduced to 0.36 m^3/tonne. This treatment system is shown in Figure 8.5.1.

The capital and operating cost data for BAT #2 are given in Tables 8.5.4 and 8.5.5.

8.5.3 BAT #3 Best at Selected World Locations

The best available treatment system for the Hot Forming wastewater was determined to be the BAT #2 technology. The modifications required to achieve a BAT #2 level of effluent quality are detailed in section 8.5.2.

8.5.4 BAT #4 Non-Lethal

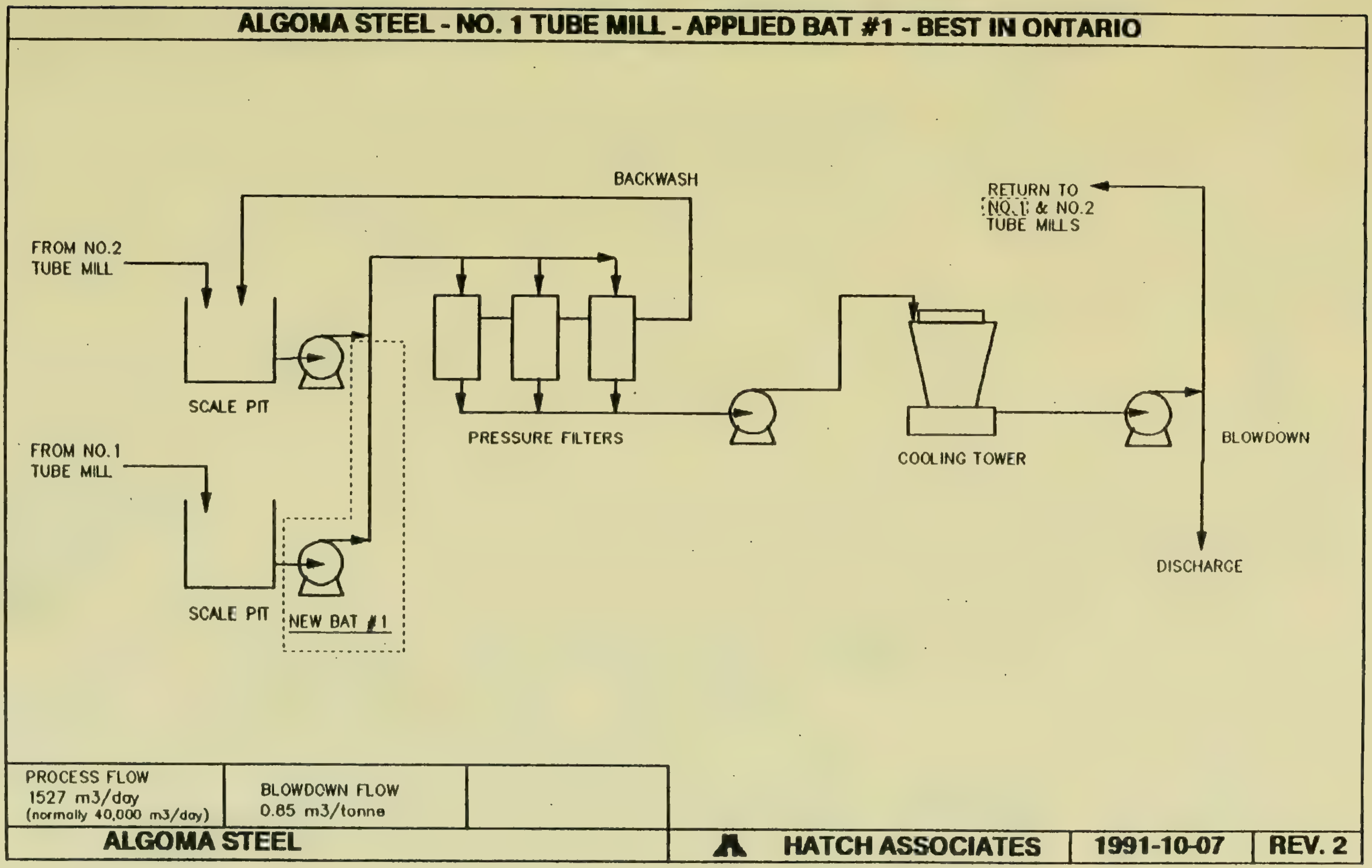
The BAT #3 wastewater treatment tecnnology for Hot Forming was determined to be the BAT #2 process. The applied BAT #2 modifications are outlined in section 8.5.2.

Based on toxicity testing during the MISA monitoring period at the No. 2 Tube Mill, the current effluent passes the Ontario Toxicity Test. Further reduction in the blowdown will increase dissolved solids in the effluent. Based on USEPA data, the reduced blowdown stream will probably pass the Ontario Toxicity Test, however, toxicity testing on the reduced blowdown stream is required to confirm this.

8.5.5 BAT #5 Virtual Elimination of Persistent Toxics

The BAT #3 wastewater treatment technology for Hot Forming was determined to be the BAT #2 process. The applied BAT #2 modifications are outlined in section 8.5.2.

Hot forming wastewater streams do not normally contain toxic metals or organics. Virtual elimination of persistent toxics is therefore not a requirement in this case and BAT #5 is not applicable.



ALGOMA STEEL - NO. 1 TUBE MILL - APPLIED BAT #1 - BEST IN ONTARIO
FROM NO.2 TUBE MILL
FROM NO.1 TUBE MILL
SCALE PIT
SCALE PIT
NEW BAT #1
BACKWASH
PRESSURE FILTERS
COOLING TOWER
RETURN TO NO.1 & NO.2 TUBE MILLS
BLOWDOWN
DISCHARGE
PROCESS FLOW
1527 m3/day
(normally 40,000 m3/day)
BLOWDOWN FLOW
0.85 m3/tonne
ALGOMA STEEL
HATCH ASSOCIATES
1991-10-07
REV. 2

FIGURE 8.5.1

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – HOT FORMING – ALGOMA – TUBE MILLS

BAT	EXISTING		BAT #1 (Note 3)		BAT #2 (Note 3)		BAT #3	BAT #4	BAT #5
Flow (m3/day)	(See Notes 1,2)		214		91				
Parameter	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)			
TSS (Note 1)	8.0	14	* 4.9	1.1	2.9	0.28	See BAT #2.	See BAT #2 (Note 4).	Not applicable.
TSS (Note 2)	* 3.6	3.0							
oil and grease (Note 1)	1.2	2.2	6.3	1.3	7.1	0.58			
oil and grease (Note 2)	1.8	1.6							

Notes:
1. No. 1 Tube Mill (not at capacity during MISA monitoring period); normal flow 40000 m3/day; MISA Monitoring Point 0400 (flow = 1527 m3/day).
2. No. 2 Tube Mill; MISA MIDES #1800 (flow = 879 m3/day).
3. Calculations based on total production at the #1 Tube Mill and the #2 Tube Mill.
4. There is no specific toxicity data available for the No. 1 Tube Mill effluent. All nine tests on Algoma's current No. 2 Tube Mill effluent, MIDES #1800, passed the Ontario Toxicity Test.

* less than RMDL

1992-02-12	TABLE 8.5.1	HATCH ASSOCIATES	PEQHFALG.WK1 PEQHFALG.ALL	REV. # 4

TABLE 8.5.2 : ALGOMA STEEL
HOT FORMING #1 + 2 TUBE MILLS - APPLIED BAT 1 COSTING

FACILITY DESCRIPTION	EST.CAP.COST $MM	ESTIMATE TYPE
Pumps	1.15	C
Inter-connecting Piping	2.18	B
Separation of NCCW	1.53	D
TOTAL	4.86	

TABLE 8.5.3 : MISA MODEL / APPLIED BAT COSTING				
Mill : ALGOMA STEEL Subcategory : HOT FORMING - # 1 & 2 SEAMLESS MILLS BAT : Applied BAT #1 (Best in Ontario) Process Flow : 40337 m3/day (BLOWDOWN = 927 m3/day) Date: 92/03/10 Filename: ALHFCOST.WK1				
1. Capital Costs				
(a) Engineering and Design				$339,000
(b) Equipment				$1,466,000
(c) Installation				$1,487,000
(d) Facilities and Structure				$233,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$1,331,000
Total Capital Cost				**$4,856,000**
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements power	kWh	9803000	$0.05	$490,000
Total Energy Requirements				$490,000
(b) Materials NaOH	kg		$0.485	$0
H2SO4	kg		$0.122	$0
chlorine	kg		$0.375	$0
polymer				
Total Materials				$0
(c) Operating Labour	manyears	0	$60,000	$0
(d) Maintenance	% of Capital	5.0%		$243,000
Total Operating & Maintenance				**$733,000**
4. Disposal of Sludges or Solid Wastes Increase over current operation.				
(a) Quantities Generated per Unit Time		12	tonne/year	$2,400
(b) Disposal Cost per Unit		$200	$/tonne	
Comments:				

TABLE 8.5.4 : ALGOMA STEEL
HOT FORMING #1 + 2 TUBE MILLS - APPLIED BAT 2 COSTING

FACILITY DESCRIPTION		EST.CAP.COST $MM	ESTIMATE TYPE
Pumps		1.15	C
Inter-connecting Piping		2.19	B
Separation of NCCW		1.53	D
	TOTAL	4.87	

TABLE 8.5.5 : MISA MODEL / APPLIED BAT COSTING				
Mill :	ALGOMA STEEL			
Subcategory :	HOT FORMING – # 1 & 2 SEAMLESS MILLS			
BAT :	Applied BAT #2 (Best in United States)			
Process Flow :	40337 m3/day (BLOWDOWN = 316 m3/day)			
Date:	92/03/10		Filename:	ALHFCOST.WK1
1. Capital Costs				
(a) Engineering and Design				$339,000
(b) Equipment				$1,469,000
(c) Installation				$1,490,000
(d) Facilities and Structure				$233,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$1,333,000
Total Capital Cost				$4,864,000
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements power	kWh	9803000	$0.05	$490,000
Total Energy Requirements				$490,000
(b) Materials polymer				
NaOH	kg		$0.485	$0
H2SO4	kg		$0.122	$0
chlorine	kg		$0.375	$0
Total Materials				$0
(c) Operating Labour	manyears		$60,000	$0
(d) Maintenance	% of Capital	5.0%		$243,000
Total Operating & Maintenance				$733,000
4. Disposal of Sludges or Solid Wastes Increase over current operation.				
(a) Quantities Generated per Unit Time		13	tonne/year	$2,600
(b) Disposal Cost per Unit		$200	$/tonne	
Comments:				

8.6 Finishing

8.6.1 Existing

Currently at Algoma, 40% of the waste pickle liquor is sold to sewage treatment plants for reuse and 60% is disposed of to the slag dump. Pickling rinse waters and fume scrubber waters are directed to the No. 1 thickener. The oily wastewater consisting of 5% animal fat is sprayed on the coal pile.

8.6.2 BAT #1 Best in Ontario

In order to upgrade the system to a BAT #1 effluent quality, the installation of a wastewater treatment system is required. A de-emulsification process must be added to treat the oily wastewater. The pickle rinses and fume scrubber waters are equalized then combined with the de-emulsified oily wastewater for further equalization and Ph adjustment. The stream flows from the Ph adjustment tanks to a clarifier and the clarifier overflow is discharged to the receiving water. These modifications are shown in Figure 8.6.1 *Algoma Steel Pickling & Cold Rolling Applied BAT #1 Best in Ontario.*

The predicted effluent quality data sheet, Table 8.6.1, for the modified treatment system is attached. Algoma does not have any plating operations at this time. Therefore zinc, total chromium and hexavalent chromium will not be present from the plating operations. However some zinc may be present in the wastewater from pickling operations. The capital and operating cost data for this treatment technology are given in Tables 8.6.2 and 8.6.3. The flows for BAT #1 are significantly lower than existing flows and will required substantial retrofit modifications to the finishing lines for flow reduction.

8.6.3 BAT #2 Best in the United States

The BAT #2 wastewater treatment system is the same as the BAT #1 process with the addition of dissolved air flotation to further separate the oil from the oily wastewater stream. This is shown in Figure 8.6.2 *Algoma Steel Pickling & Cold Rolling Applied BAT #2 Best in the United States.*

The capital and operating cost data for this treatment technology are given in Tables 8.6.4 and 8.6.5.

8.6.4 BAT #3 Best at Selected World Locations

The best available treatment system for the Finishing wastewater was determined to be the BAT #2 technology. The modifications required to achieve a BAT #2 level of effluent quality are detailed in section 8.6.3.

8.6.5 BAT #4 Non-Lethal

The BAT #3 wastewater treatment technology for Bat #4 Finishing was determined to be the BAT #2 process. The applied BAT #2 modifications are outlined in section 8.6.3.

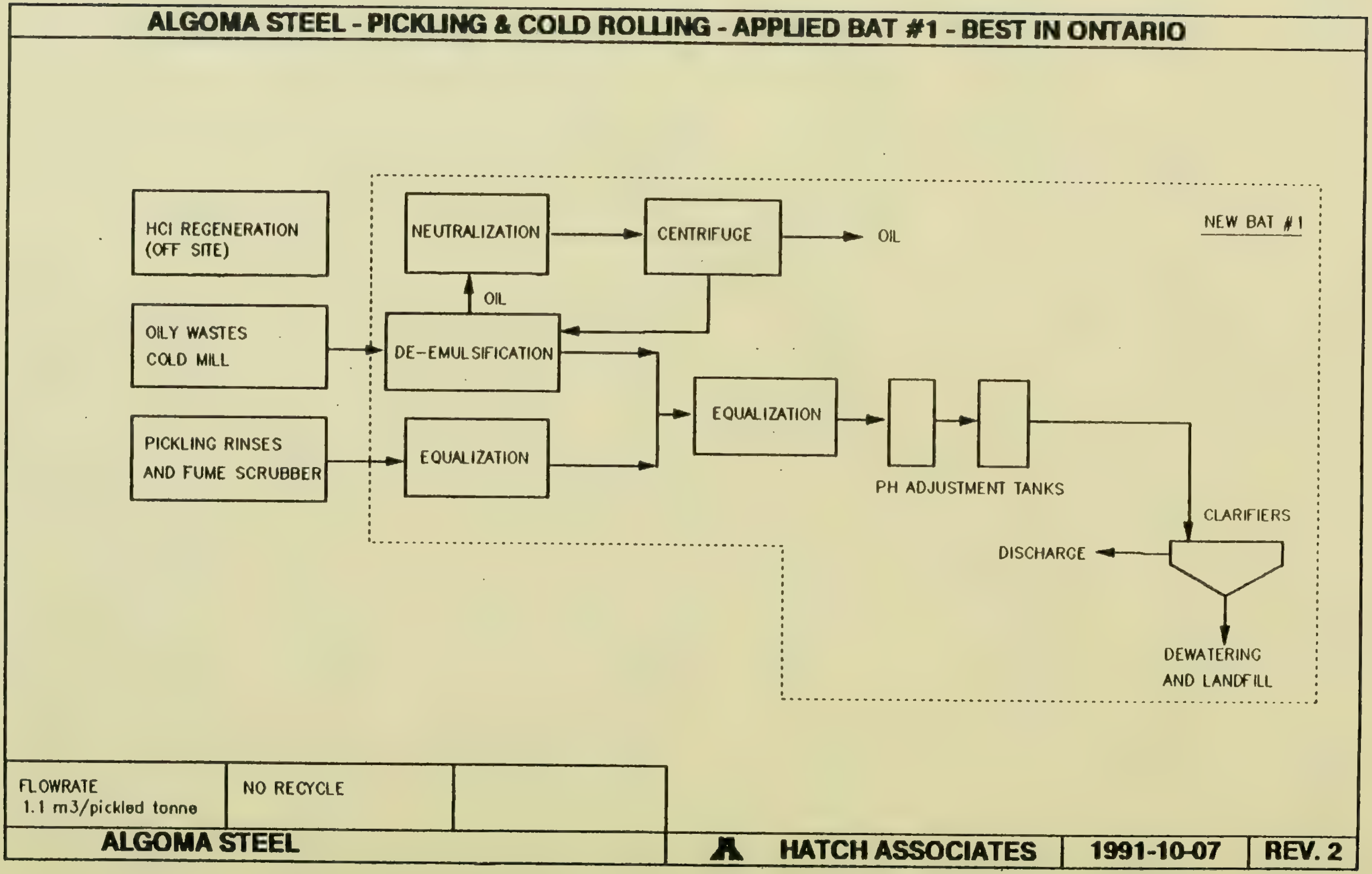
There is no specific toxicity data available for the Finishing wastewater stream. However, the zinc, chromium and hexavalent chromium were determined to be below the single contaminant LC50 values. Therefore, the effluent may pass the Ontario Toxicity Test depending on synergistic effects and hardness. The synergistic effects of the several contaminants in the effluent are not known and cannot be predicted. No demonstrated technologies are known to further reduce the concentrations of metal toxics to lower levels than those measured in this wastewater. This effluent can either be discharged to Davignon Creek or the Terminal Lagoon.

8.6.6 BAT #5 Virtual Elimination of Persistent Toxics

The BAT #3 wastewater treatment technology for Finishing was determined to be the BAT #2 process. The applied BAT #2 modifications are outlined in section 8.6.3.

The Finishing wastewater stream is expected to contain low levels of metal toxic contaminants. No demonstrated technologies are known to further reduce the concentrations of these compounds to lower levels those than measured in the wastewater stream. Virtual elimination of persistent toxics can only be assured by zero discharge. This may be achieved with further treatment by ultrafiltration and ion exchange, or evaporation which may permit the treated water

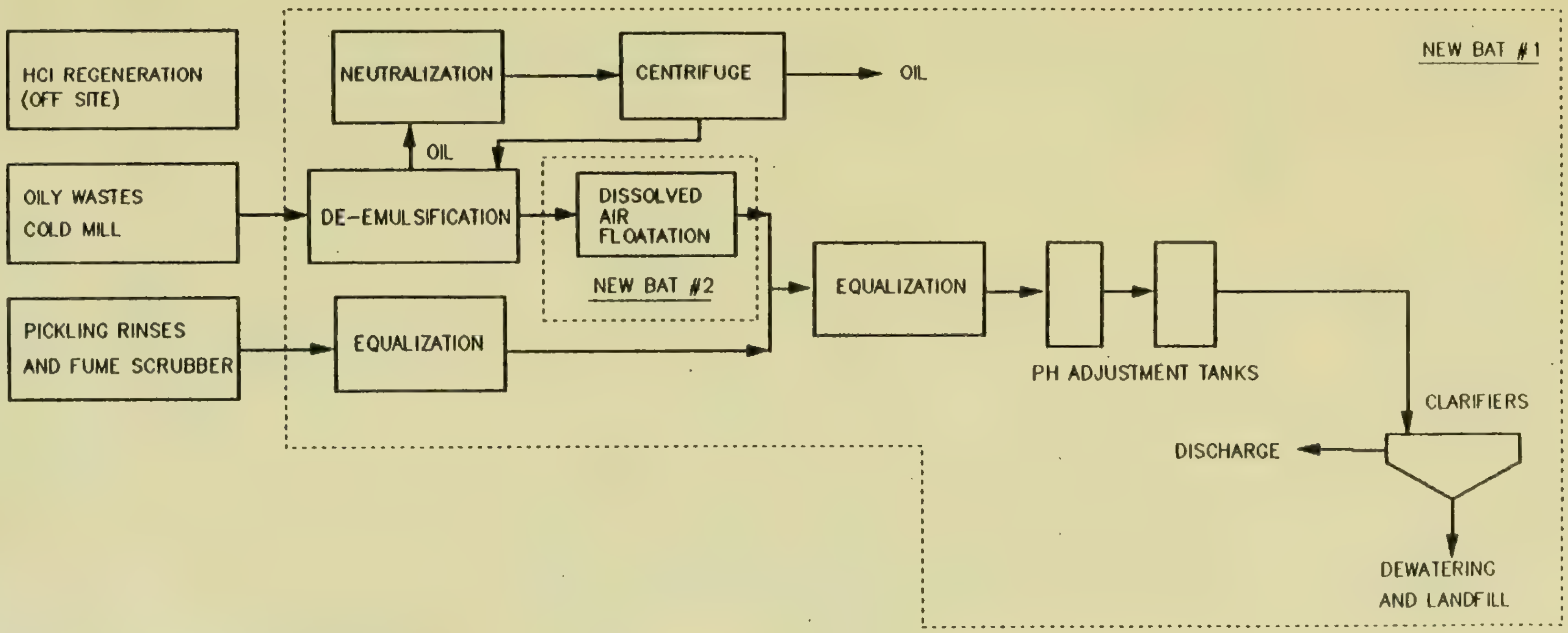
to be recycled to the process. However, these treatment technologies are not demonstrated in this industrial sector.



ALGOMA STEEL - PICKLING & COLD ROLLING - APPLIED BAT #1 - BEST IN ONTARIO
HCl REGENERATION (OFF SITE)
OILY WASTES COLD MILL
PICKLING RINSES AND FUME SCRUBBER
NEUTRALIZATION
CENTRIFUGE
OIL
OIL
DE-EMULSIFICATION
EQUALIZATION
EQUALIZATION
PH ADJUSTMENT TANKS
NEW BAT #1
CLARIFIERS
DISCHARGE
DEWATERING AND LANDFILL
FLOWRATE 1.1 m3/pickled tonne
NO RECYCLE
ALGOMA STEEL
HATCH ASSOCIATES
1991-10-07
REV. 2

FIGURE 8.6.1

ALGOMA STEEL - PICKLING & COLD ROLLING - APPLIED BAT #2 - BEST IN UNITED STATES



FLOWRATE 6.1 m3/pickled tonne	NO RECYCLE			
ALGOMA STEEL		**HATCH ASSOCIATES**	**1991-10-03**	**REV. 2**

FIGURE 8.6.2

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – FINISHING – ALGOMA (Note 1)

BAT	EXISTING	BAT #1 (Note 3)		BAT #2 (Notes 3,4)		BAT #3	BAT #4	BAT #5
Flow (m3/day)	6270 (Note 2)	1259		6984				
Parameter		Average Conc.	Average Loading	Average Conc.	Average Loading			
		(mg/L)	(kg/day)	(mg/L)	(kg/day)			
TSS		487	607	4.8	33			
oil and grease	No data available.	68	86	2.3	16	See BAT #2.	See BAT #2,	No demonstrated
lead	Stream combined with	0.088	0.11	–	–			technology in
zinc	other effluents and	0.15	0.19	0.054	0.38			this industry
chromium	discharged to the	–	–	–	–			sector.
hexavalent chromium	Main Filter Plant.	–	–	–	–			

Notes:
1. The calculations were based on Acid Pickling production.
2. Existing flow estimated by Algoma. Refer to Algoma Mill Visit Report – Volume III.
3. Algoma's Finishing Operations include Acid Pickling and Cold Rolling, neither of which will transfer chromium or hexavalent chromium to the wastewater. Some zinc will be transferred to the wastewater in the Acid Pickling operation.
4. BAT #2 is based on flow, loadings and concentrations from Finishing BAT #2 (National, Midwest). Algoma's Existing flow is less than the BAT #2 flow.

TABLE 8.6.2 : ALGOMA STEEL
FINISHING - APPLIED BAT 1 COSTING

FACILITY DESCRIPTION		EST.CAP.COST $MM	ESTIMATE TYPE
Acid waste treatment plant		5.27	A
Oily waste treatment plant		10.37	A
	TOTAL	15.64	

TABLE 8.6.3 : MISA MODEL / APPLIED BAT COSTING

Mill : ALGOMA STEEL
Subcategory : ACID PICKLING + COLD ROLLING
BAT : Applied BAT #1 (Best in Ontario)
Process Flow : BLOWDOWN = 1643 m3/day
Date: 92/03/10 Filename: ALFICOST.WK1

1. Capital Costs				
(a) Engineering and Design				$1,090,000
(b) Equipment				$3,406,000
(c) Installation				$3,679,000
(d) Facilities and Structure				$3,167,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$4,283,000
Total Capital Cost				$15,625,000
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements power	kWh	4411000	$0.05	$221,000
Total Energy Requirements				$221,000
(b) Materials NaOH	kg	164000	$0.485	$80,000
H2SO4	kg	22000	$0.122	$3,000
chlorine	kg	55000	$0.375	$21,000
polymer				$143,000
Total Materials				$247,000
(c) Operating Labour	manyears	6	$60,000	$360,000
(d) Maintenance	% of Capital	5.0%		$781,000
Total Operating & Maintenance				$1,609,000
4. Disposal of Sludges or Solid Wastes Increase over current operation.				
(a) Quantities Generated per Unit Time			tonne/year	$0
(b) Disposal Cost per Unit		$200	$/tonne	

Comments:

NO INFORMATION AVAILABLE ON CURRENT SOLIDS LOADINGS

TABLE 8.6.4 : ALGOMA STEEL FINISHING - APPLIED BAT 2 COSTING

FACILITY DESCRIPTION	EST.CAP.COST $MM	ESTIMATE TYPE
Acid waste treatment plant	5.27	A
Oily waste treatment plant	10.37	A
Dissolved air flotation unit + associated sludge treatment	1.51	C
TOTAL	17.15	

TABLE 8.6.5 : MISA MODEL / APPLIED BAT COSTING				
Mill :	ALGOMA STEEL			
Subcategory :	ACID PICKLING + COLD ROLLING			
BAT :	Applied BAT #2 (Best in United States)			
Process Flow :	BLOWDOWN = 1643 m3/day			
Date:	92/03/10		Filename:	ALFICOST.WK1

1. Capital Costs	
(a) Engineering and Design	$1,195,000
(b) Equipment	$3,735,000
(c) Installation	$4,035,000
(d) Facilities and Structure	$3,474,000
(e) Land	$0
(f) Other (Construction Expenses & Contingency)	$4,697,000
Total Capital Cost	**$17,136,000**
2. One Time Consulting or Service Expenses	

3. Operating and Maintenance Costs		Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements	power	kWh	4411000	$0.05	$221,000
Total Energy Requirements					$221,000
(b) Materials	polymer				
	NaOH	kg	164000	$0.485	$11,000
	H2SO4	kg	22000	$0.122	$7,000
	chlorine	kg	55000	$0.375	$21,000
Total Materials					$39,000
(c) Operating Labour		manyears	6	$60,000	$360,000
(d) Maintenance		% of Capital	5.0%		$857,000
Total Operating & Maintenance					**$1,477,000**

4. Disposal of Sludges or Solid Wastes Increase over current operation.			
(a) Quantities Generated per Unit Time		tonne/year	$0
(b) Disposal Cost per Unit	$200	$/tonne	

Comments:

NO INFORMATION AVAILABLE ON CURRENT SOLIDS LOADINGS

8.7 Integrated Mills Including Finishing

8.7.1 BAT #1 Best in Ontario

Currently at Algoma, there is limited recirculation of process water within the facility. It is proposed to install recycle systems for all process areas except for the cokemaking byproducts and Finishing areas. The additional wastewater treatment required for each system is detailed in the above sections. A combined Blowdown Treatment Plant is proposed for the Cokemaking, Ironmaking and Steelmaking wastewaters. The Cokemaking and Ironmaking wastewater will be combined for metals removal and chlorination then combined with the Steelmaking wastewater for filtration prior to discharge. A separate metals removal step will be installed for the Steelmaking wastewater.

The water from the continuous casters and the primary, flat and section mills is filtered at the Main Filter Plant then cooled and recycled to the processes. A recirculation system is installed on the No. 1 Tube Mill with wastewater treatment at the No. 2 Tube Mill. These modifications are shown in Figure 8.7.1 *Algoma Steel Integrated Mills Including Finishing Applied BAT #1 Best in Ontario*.

The predicted effluent quality data sheet, Table 8.7.1, for these modifications is attached. As discussed in Section 7.1, this table is presented for information purposes only. The table summarizes the effluent data for each BAT option. BAT #1 is based on data for Stelco 342 LEW's final effluent and data for Dofasco's Finishing effluent. BAT #2A is based on National Steel, Granite City which is an integrated mill with central treatment facilities and finishing operations. BAT #2B represents the sum of the BAT #2 options for all categories. Model BAT #3 is based on data for Stelco LEW's final effluent and data for National Steel Midwest for finishing effluent.

8.7.2 BAT #2 Best in the United States

The overall wastewater treatment processes and recirculation systems for BAT #2 are similar to the BAT #1 modifications detailed in section 8.7.1.

8.7.3 BAT #3 Best at Selected World Locations

The best available integrated wastewater treatment facility was determined to be the BAT #1 facility. The applied BAT #1 modification are described in section 8.7.1.

8.7.4 BAT #4 Non-Lethal

The BAT #3 wastewater treatment technology for Bat #4 Integrated Mills including Finishing was determined to be the BAT #1 process. The applied BAT #1 modifications are outlined in section 8.7.1.

The treated wastewater streams from the various process areas are not combined in a centralized treatment plant prior to discharge, as at Stelco LEW. Therefore, the Stelco LEW toxicity data cannot be used to assess the toxicity of the discharges from Algoma. Assessments of the toxicity of the wastewater streams discharged from this facility are described in the previous sections.

8.7.5 BAT #5 Virtual Elimination of Persistent Toxics

The BAT #3 wastewater treatment technology for Integrated Mill including Finishing was determined to be the BAT #1 process. The applied BAT #1 modifications are outlined in section 8.7.1.

Assessments of each of the effluent streams for persistent toxic contaminants are described in the previous sections.

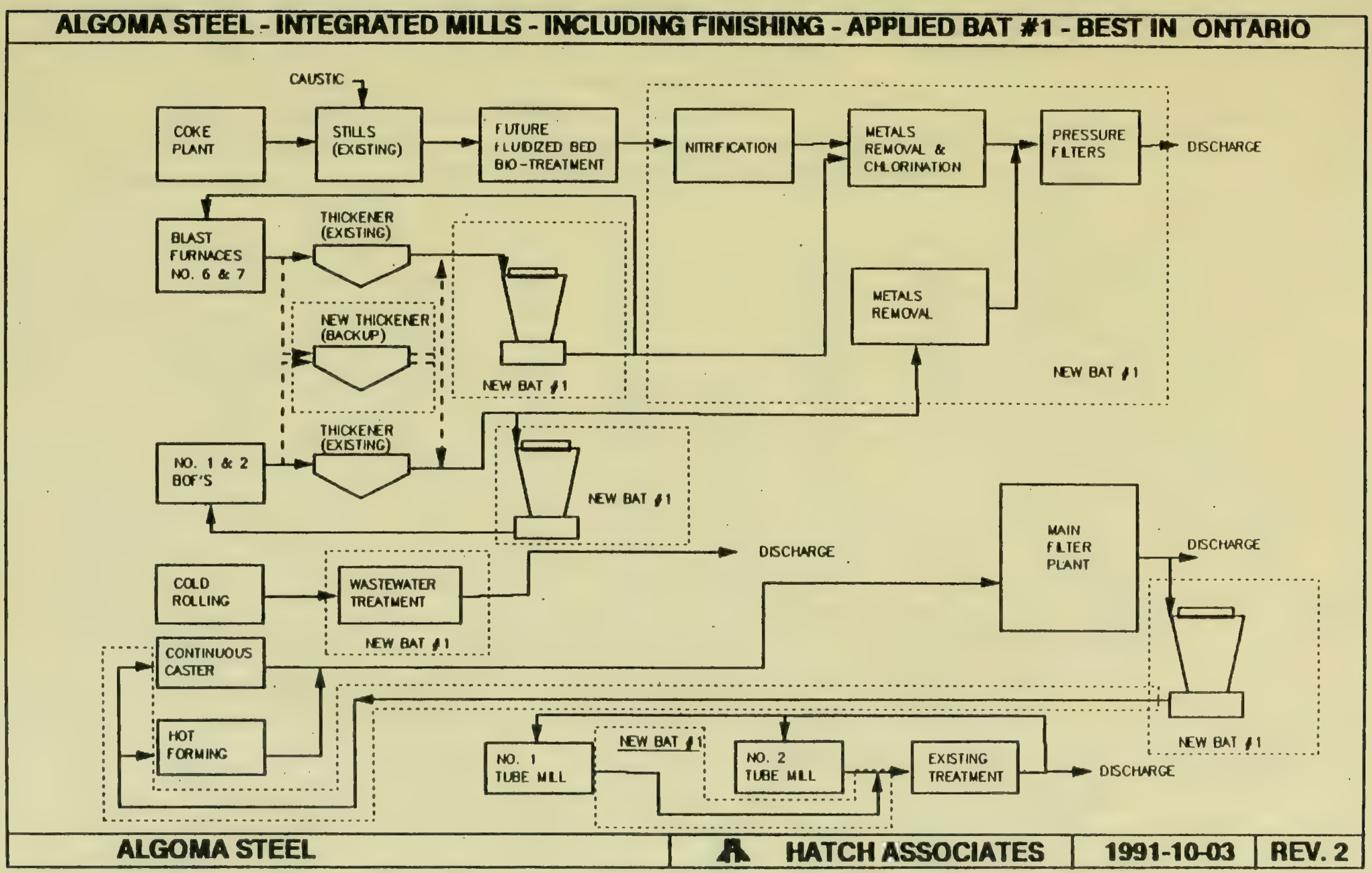

ALGOMA STEEL - INTEGRATED MILLS - INCLUDING FINISHING - APPLIED BAT #1 - BEST IN ONTARIO
CAUSTIC
COKE PLANT
STILLS (EXISTING)
FUTURE FLUIDIZED BED BIO-TREATMENT
NITRIFICATION
METALS REMOVAL & CHLORINATION
PRESSURE FILTERS
DISCHARGE
BLAST FURNACES NO. 6 & 7
THICKENER (EXISTING)
NEW THICKENER (BACKUP)
NEW BAT #1
METALS REMOVAL
NEW BAT #1
THICKENER (EXISTING)
NO. 1 & 2 BOF'S
NEW BAT #1
DISCHARGE
MAIN FILTER PLANT
DISCHARGE
COLD ROLLING
WASTEWATER TREATMENT
NEW BAT #1
CONTINUOUS CASTER
HOT FORMING
NEW BAT #1
NO. 1 TUBE MILL
NO. 2 TUBE MILL
EXISTING TREATMENT
DISCHARGE
NEW BAT #1
ALGOMA STEEL
HATCH ASSOCIATES
1991-10-03
REV. 2

FIGURE 8.7.1

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – INCLUDING FINISHING – ALGOMA

BAT	EXISTING (Note 1)		BAT #1 (Note 2)		BAT #2A (Note 3)		BAT #2B (Note 2)		BAT #3 (Note 2)		BAT #4	BAT #5
Flow (m3/day)	498400		31213		63731		12784		36938			
Parameter	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)		
TSS	6.4	3211	24	753	5.4	344	11	142	4.9	180		
oil and grease	* 0.95	471	4.1	127	4.9	312	2.6	33	1.6	57		
ammonia + ammonium	5.7	2823	* 0.080	2.5	0.59	38	8.0	102	0.067	2.5	See	Note 4
cyanide total	0.15	75	0.11	3.4	0.0034	0.22	0.75	9.6	0.091	3.4	BAT #3.	
phenolics (4AAP)	0.031	16	0.0022	0.070	0.0029	0.18	0.015	0.19	0.0019	0.070		
lead	* 0.017	8.3	0.034	1.1	0.0047	0.30	0.0070	0.089	0.026	0.96		
zinc	0.097	48	0.067	2.1	0.045	2.9	0.059	0.76	0.062	2.3		
benzene	* 0.00045	0.22	* 0.00025	0.0076	< 0.01	-	0.00030	0.0038	0.00021	0.0076		
benzo(a)pyrene	* 0.00040	0.20	* 0.00049	0.015	< 0.01	-	0.0022	0.028	0.00041	0.015		
naphthalene	* 0.00076	0.38	* 0.00029	0.0089	< 0.01	-	0.0011	0.015	0.00024	0.0089		
chromium	* 0.011	5.4	0.041	1.3	-	-	0.028	0.35	0.017	0.64		
hexavalent chromium	* 0.0090	4.5	-	-	-	-	0.0059	0.076	0.0020	0.076		

Notes:
1. Sum of all process waste water discharges from Algoma (MISA Monitoring Points 0100, 0400, 0700 and 1800).
2. Loading (kg/day) = Loading Excluding Finishing (g/tonne) times Steelmaking Production (tonne/day) + Loading Finishing (g/tonne) x Acid Pickling Production (tonne/day).
3. Calculations based on Algoma's Steelmaking production only.
4. No demonstrated technology in this industry sector.

* less than RMDL

1992-02-13	TABLE 8.7.1	HATCH ASSOCIATES	PEQCTALG.WK1 PEQCTALG.ALL	REV. # 3

9.0 APPLIED BAT ATLAS SPECIALTY STEELS

9.1 Existing

Atlas Speciality Steels is the only specialty steel facility in Ontario. Wastewater from the casting, hot forming and finishing operations at Atlas Specialty Steels is collected in scale pits and filtered in gravity sand filters. A portion of the filtered water is recycled to the processes and the balance is used for non-contact cooling or discharged. The backwash from the filters is clarified in settling tanks then recycled to the filter inlet.

The kolene rinses from the finishing process are treated in a hexavalent chromium reduction step then combined with the pickle rinses and the waste acid solidification plant effluent for pH adjustment with lime. Polymer is added to the second pH adjustment tank to precipitate solids prior to the clarifier. The clarifier underflow is directed to the Waste Acid Solidification Plant and the overflow is directed to the scale pit with the other wastewater streams. This treatment system is shown in Figures 9.1 and 9.2 *Atlas Specialty Steels Flow Diagram*.

9.2 BAT #1 Best in Ontario

Atlas Specialty Steel is the only Specialty Steels facility in Ontario. Therefore, no BAT #1 was chosen for this category.

9.3 BAT #2 Best in the United States

In order to achieve a BAT #2 level of effluent quality, two cooling towers are required after the sand filters to increase the water recirculation rate. Additional motor room cooling will also be required with this modification. The Finishing wastewaters should be treated and discharged separately from this system. A new equalization tank is required for the pickle rinses and the effluent from the waste acid solidification plant. The CEVAM flow should be returned to the distribution system. The North Plant Oil Quench and South Plant Oil Quench require coolers. These modifications are shown in Figures 9.3 and 9.4 *Atlas Specialty Steels Applied BAT #2 Best in the United States*.

The predicted effluent quality data sheet, Table 9.1, for the modified treatment system is attached. The capital and operating cost data for this treatment technology are given in Table 9.2.

In accordance with Volume I, page 80, vacuum degassing is not pursued as a separate process category. An appropriate allowance will be required for limit setting.

9.4 BAT #3 Best at Selected World Locations

The best available Specialty Steels wastewater treatment facility was determined to be the BAT #2 facility. The applied BAT #2 modifications are described in section 9.3.

9.5 BAT #4 Non-Lethal

The BAT #3 wastewater treatment technology for Bat #4 Specialty Steels was determined to be the BAT #2 process. The applied BAT #2 modifications are outlined in section 9.3.

There is no specific toxicity data available for the Hot Forming and Finishing wastewater streams. However, based on an assessment of the expected effluent characteristics, specifically the single contaminant LC50 values, the toxicity of the combined effluent, as determined by the Ontario Toxicity Test, is probably marginal. The synergistic effects of the several contaminants in the effluent are not known and cannot be predicted. If the future combined effluent fails the Ontario Toxicity Test, the Finishing wastewater may be treated by ultrafiltration and ion exchange, or evaporation which may permit the treated water to be recycled to the processes. However, these treatment technologies are not demonstrated in this industrial sector.

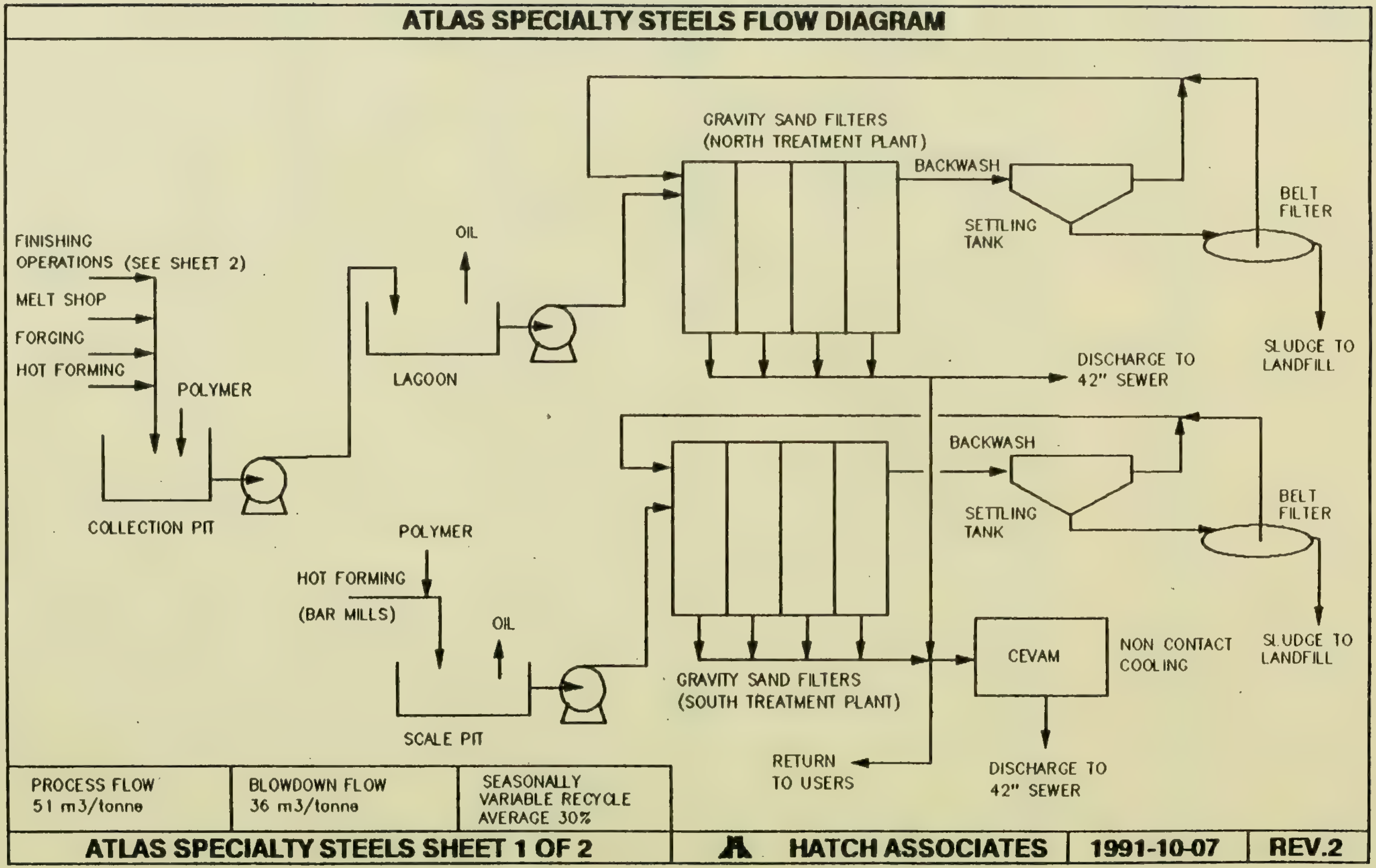
9.6 BAT #5 Virtual Elimination of Persistent Toxics

The BAT #3 wastewater treatment technology for Specialty Steels was determined to be the BAT #2 process. The applied BAT #2 modifications are outlined in section 9.3.

Hot Forming wastewater streams do not normally contain toxic metals or organics. Virtual elimination of persistent toxics is therefore not a requirement in this case and BAT #5 is not applicable.

The Finishing wastewater stream is expected to contain very low levels of nickel, which is a persistent bioaccumulative toxic, and other toxic metal contaminants. No demonstrated technologies are known to further reduce the concentrations of these compounds. Virtual elimination of persistent toxics can only be assured by zero discharge. This may be achieved with further treatment by ultrafiltration and ion exchange, or evaporation which may permit the treated water to be recycled to the process. However, these treatment technologies are not demonstrated in this industrial sector.

The Predicted Effluent Quality data sheet for Atlas Specialty Steels is given in Table 9.1. The table shows the effluent quality of the existing wastewater stream as well as the predicted effluent quality which would result if BAT #2 technology were implemented. The BAT #2 Predicted Effluent Quality was calculated by multiplying the model BAT #2-A finishing wastewater data (m^3/tonne and g/tonne) by the total Finishing production at Atlas and by multiplying the Model BAT #2-B data (m^3/tonne and g/tonne) by the Steelmaking production at Atlas, and then adding the two components.



ATLAS SPECIALTY STEELS FLOW DIAGRAM
FINISHING OPERATIONS (SEE SHEET 2)
MELT SHOP
FORGING
HOT FORMING
POLYMER
COLLECTION PIT
OIL
LAGOON
GRAVITY SAND FILTERS (NORTH TREATMENT PLANT)
BACKWASH
SETTLING TANK
BELT FILTER
SLUDGE TO LANDFILL
DISCHARGE TO 42" SEWER
BACKWASH
SETTLING TANK
BELT FILTER
SLUDGE TO LANDFILL
POLYMER
HOT FORMING
(BAR MILLS)
OIL
SCALE PIT
GRAVITY SAND FILTERS (SOUTH TREATMENT PLANT)
CEVAM
NON CONTACT COOLING
RETURN TO USERS
DISCHARGE TO 42" SEWER
PROCESS FLOW 51 m3/tonne
BLOWDOWN FLOW 36 m3/tonne
SEASONALLY VARIABLE RECYCLE AVERAGE 30%
ATLAS SPECIALTY STEELS SHEET 1 OF 2
HATCH ASSOCIATES
1991-10-07
REV.2

FIGURE 9.1

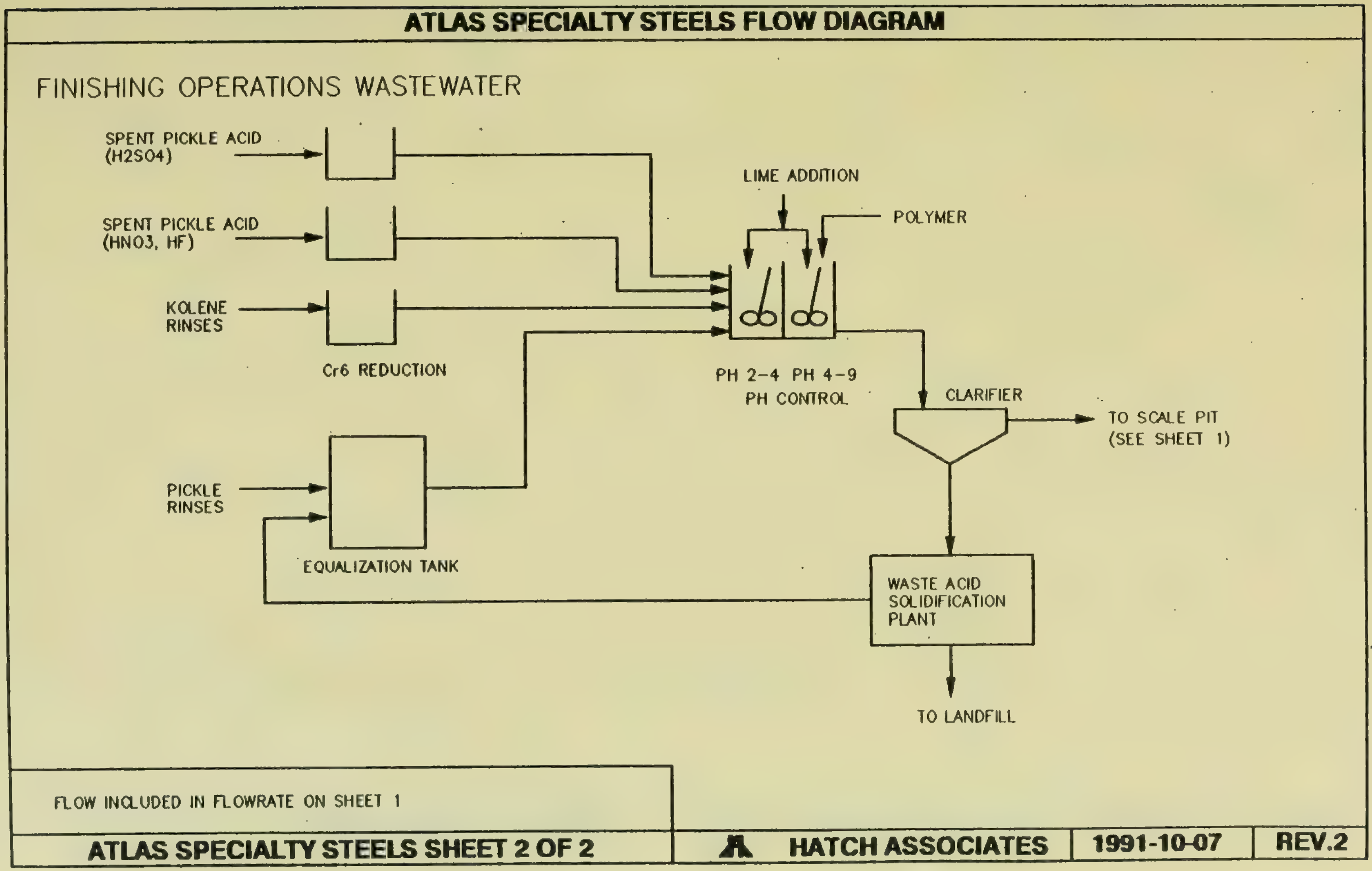
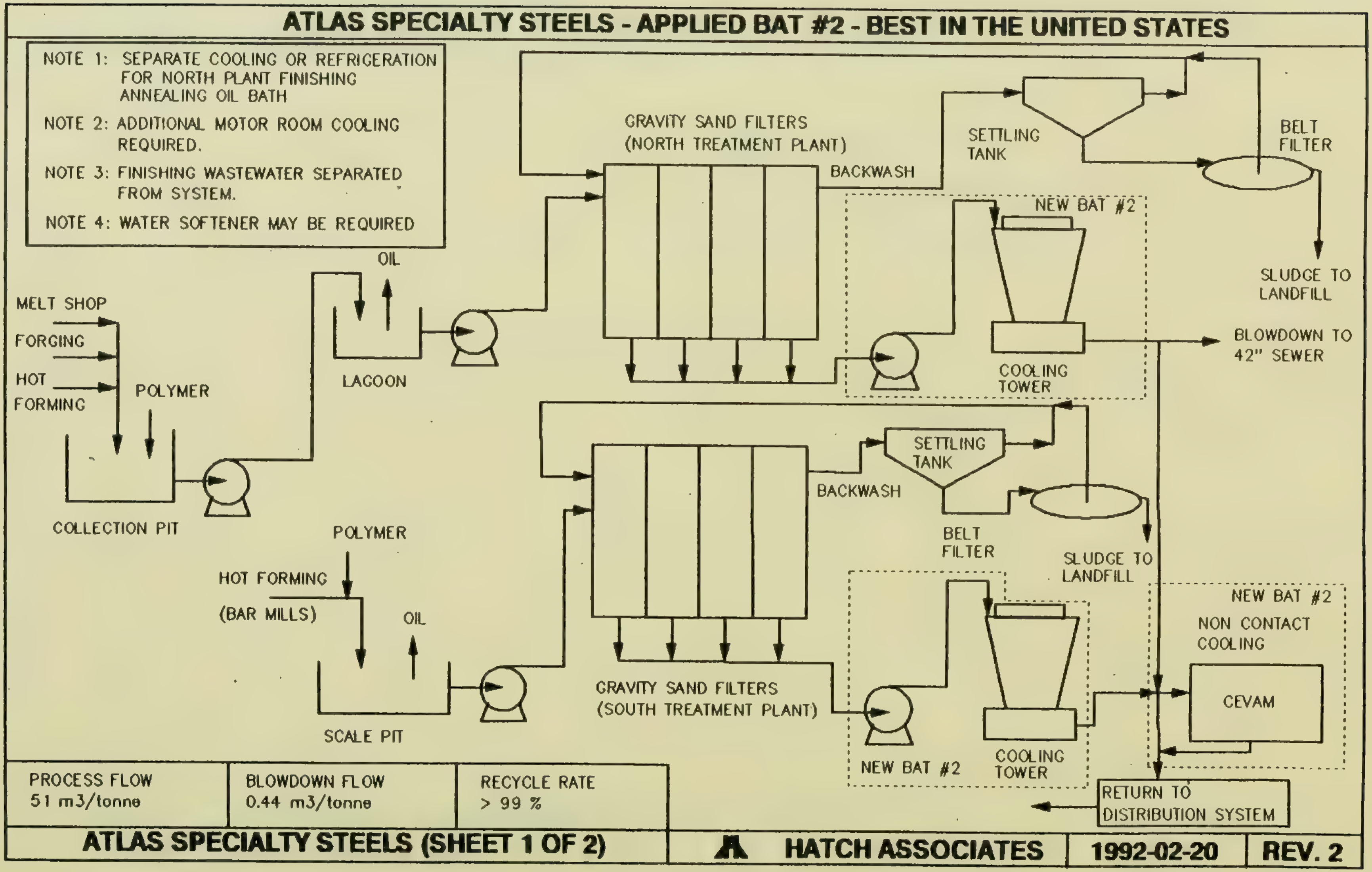
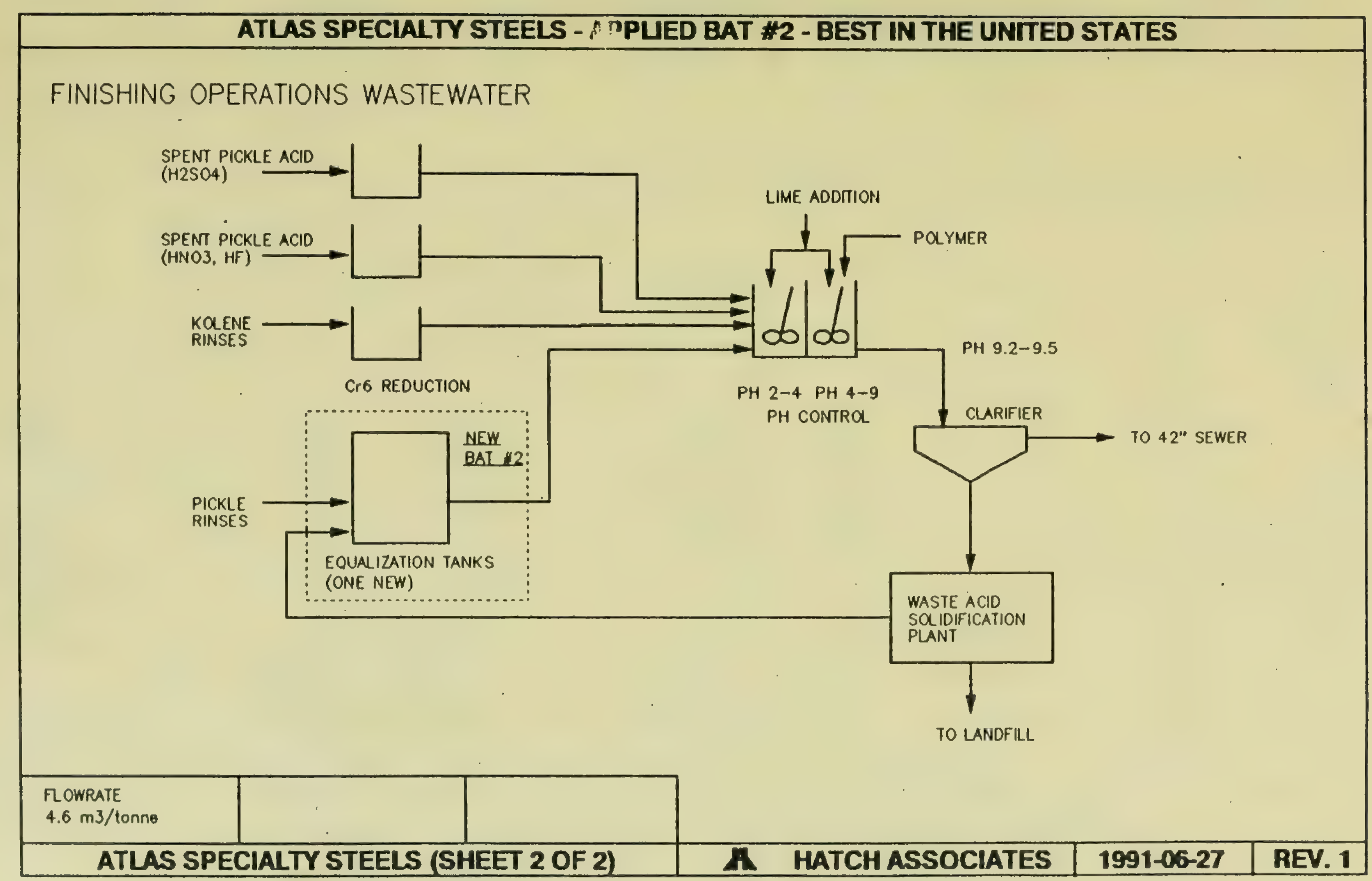

ATLAS SPECIALTY STEELS FLOW DIAGRAM
FINISHING OPERATIONS WASTEWATER
SPENT PICKLE ACID (H2SO4)
SPENT PICKLE ACID (HNO3, HF)
KOLENE RINSES
Cr6 REDUCTION
PICKLE RINSES
EQUALIZATION TANK
LIME ADDITION
POLYMER
PH 2-4 PH 4-9
PH CONTROL
CLARIFIER
TO SCALE PIT (SEE SHEET 1)
WASTE ACID SOLIDIFICATION PLANT
TO LANDFILL
FLOW INCLUDED IN FLOWRATE ON SHEET 1
ATLAS SPECIALTY STEELS SHEET 2 OF 2
HATCH ASSOCIATES
1991-10-07
REV.2

FIGURE 9.2



ATLAS SPECIALTY STEELS - APPLIED BAT #2 - BEST IN THE UNITED STATES
NOTE 1: SEPARATE COOLING OR REFRIGERATION FOR NORTH PLANT FINISHING ANNEALING OIL BATH
NOTE 2: ADDITIONAL MOTOR ROOM COOLING REQUIRED.
NOTE 3: FINISHING WASTEWATER SEPARATED FROM SYSTEM.
NOTE 4: WATER SOFTENER MAY BE REQUIRED
MELT SHOP
FORGING
HOT FORMING
POLYMER
COLLECTION PIT
OIL
LAGOON
GRAVITY SAND FILTERS
(NORTH TREATMENT PLANT)
BACKWASH
SETTLING TANK
BELT FILTER
SLUDGE TO LANDFILL
NEW BAT #2
COOLING TOWER
BLOWDOWN TO 42" SEWER
POLYMER
HOT FORMING
(BAR MILLS)
OIL
SCALE PIT
GRAVITY SAND FILTERS
(SOUTH TREATMENT PLANT)
BACKWASH
SETTLING TANK
BELT FILTER
SLUDGE TO LANDFILL
NEW BAT #2
COOLING TOWER
NEW BAT #2
NON CONTACT COOLING
CEVAM
RETURN TO DISTRIBUTION SYSTEM
PROCESS FLOW
51 m3/tonne
BLOWDOWN FLOW
0.44 m3/tonne
RECYCLE RATE
> 99 %
ATLAS SPECIALTY STEELS (SHEET 1 OF 2)
HATCH ASSOCIATES
1992-02-20
REV. 2

FIGURE 9.3



ATLAS SPECIALTY STEELS - APPLIED BAT #2 - BEST IN THE UNITED STATES
FINISHING OPERATIONS WASTEWATER
SPENT PICKLE ACID (H2SO4)
SPENT PICKLE ACID (HNO3, HF)
KOLENE RINSES
Cr6 REDUCTION
LIME ADDITION
POLYMER
PH 2-4 PH 4-9
PH CONTROL
PH 9.2-9.5
CLARIFIER
TO 42" SEWER
NEW BAT #2
PICKLE RINSES
EQUALIZATION TANKS (ONE NEW)
WASTE ACID SOLIDIFICATION PLANT
TO LANDFILL
FLOWRATE
4.6 m3/tonne
ATLAS SPECIALTY STEELS (SHEET 2 OF 2)
HATCH ASSOCIATES
1991-06-27
REV. 1

FIGURE 9.4

PREDICTED EFFLUENT QUALITY

SPECIALTY MILLS – ATLAS SPECIALTY STEELS

BAT	EXISTING (Note 1)		BAT #1	BAT #2 (Note 2)		BAT #3	BAT #4	BAT #5
Flow (m3/day)	15149			272				
Parameter	Average Conc. (mg/L)	Average Loading (kg/day)		Average Conc. (mg/L)	Average Loading (kg/day)			
TSS	6.2	90		10	2.7			
oil and grease	2.8	38	Not	4.2	1.1	See BAT #2.	See BAT #2	No demonstrated
lead	* 0.017	0.31	applicable.	0.045	0.012		(Note 3).	technology in
zinc	0.053	0.94		0.012	0.0034			this industry
chromium	0.020	0.30		0.037	0.010			sector.
hexavalent chromium	* 0.0050	0.077		0.0069	0.0019			
cadmium	* 0.00020	0.0030		0.0036	0.0010			
nickel	0.16	2.5		0.069	0.019			

Notes:
1. Atlas data was taken directly from MISA Monitoring Point 0100, 42" SEWER.
2. Calculations are based on BAT #2 – A (Finishing) times Atlas Finishing Production plus BAT #2 – B (Excluding Finishing) times Atlas Steelmaking Production.
3. Atlas current effluent passed the Ontario Toxicity Test during the MISA Monitoring Period six times in eleven tests for Daphnia Magna and eleven times in eleven tests for Rainbow Trout.

* less than RMDL

1992-02-13	TABLE 9.1	HATCH ASSOCIATES	PEQSPATL.WK1 PEQSPATL.ALL	REV. # 4

TABLE 9.2 : MISA MODEL / APPLIED BAT COSTING				
Mill : Atlas Specialty Steel				
Subcategory : Specialty Mills				
BAT : 2 and 3				
Process Flow : 276 m3/Day (BLOWDOWN FLOW AT RATED PRODUCTION)				
Date: 92/03/10				ATLASJJ.WK1
1. Capital Costs				
(a) Engineering and Design				$436,000
(b) Equipment				$1,375,000
(c) Installation				$1,482,000
(d) Facilities and Structure				$1,243,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$1,713,000
Total Capital Cost				$6,249,000
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements	kWh	3094193	$0.05	$155,000
Total Energy Requirements				$155,000
(b) Materials	% of Capital	1.00%		$62,000
				$0
				$0
Total Materials				$62,000
(c) Operating Labour	Man years	0.25	$60,000	$15,000
(d) Maintenance	% of Capital	5.00%		$312,000
Total Operating and Maintenance				$544,000
4. Disposal of Sludges or Solid Wastes				
(a) Quantities Generated per Unit Time				
(b) Disposal Cost per Unit				
Comments:				

10.0 APPLIED BAT DOFASCO INC.

10.1 Cokemaking

10.1.1 BAT #1 Best in Ontario

In order to achieve an effluent quality equivalent to Model BAT #1, the biological treatment system must be upgraded. A new equalization tank and aeration basins are required to treat the effluent from the ammonia stills. In addition, a clarifier and a thickener are required to remove the sludge from the wastewater. The overflow from the clarifier should be directed to a blowdown treatment plant for treatment. This treatment system should consist of equalization, metals precipitation, chlorination and filtration prior to discharge. This treatment system is shown in Figure 10.1.1 *Dofasco Inc. Cokemaking Applied BAT #1 Best in Ontario.*

The predicted effluent quality data sheet, Table 10.1.1, is attached. The capital and operating cost data for these modifications are given in Table 10.1.2.

10.1.2 BAT #2 Best in the United States

The BAT #2 treatment system is the same as the BAT #1 treatment system without the blowdown treatment plant. The BAT #2 treatment system is shown in Figure 10.1.2 *Dofasco Inc. Cokemaking Applied BAT #2 Best in the United States*. The BAT #1 modifications are described in section 10.1.1.

The capital and operating cost data for the BAT #2 modifications are given in Table 10.1.3

10.1.3 BAT #3 Best at Selected World Locations

BAT #1 was determined to be the best available treatment technology. The modifications required for applied BAT #1 are detailed in section 10.1.1.

10.1.4 BAT #4 Non-Lethal

The BAT #3 wastewater treatment technology for Cokemaking was determined to be the BAT #1 process. The applied BAT #1 modifications are outlined in section 10.1.1.

There is no specific toxicity data available for the BAT #3 Cokemaking wastewater stream. However, based on an assessment of the expected effluent characteristics, specifically the single contaminant LC50 values, the effluent toxicity, as determined by the Ontario Toxicity Test, is probably marginal. The synergistic effects of the several contaminants in the effluent are not known and cannot be predicted. No demonstrated technologies are known to further reduce the concentrations of organic toxics to lower levels than those measured in this wastewater. This stream is not discharged directly to the receiving water, but is co-treated with the Ironmaking and Steelmaking blowdown streams in a Blowdown Treatment Plant and may be combined with other streams prior to discharge to Hamilton Harbour. No assessment of the effluent toxicity can be made at this time.

10.1.5 BAT #5 Virtual Elimination of Persistent Toxics

The BAT #3 wastewater treatment technology for Cokemaking was determined to be the BAT #1 process. The applied BAT #1 modifications are outlined in section 10.1.1.

This wastewater stream is expected to contain very low levels of benzo(a)pyrene (persistent bioaccumulative) and other organic toxics. No demonstrated technologies are known to further reduce the concentrations of organic toxics. The precise scientific definition of "virtual elimination of persistent toxics" is not established, but it is likely that this goal will be interpreted as zero discharge for persistent bioaccumulative toxics. Benzo(a)pyrene is listed in this category. No discharge to receiving water may be achieved with further treatment by ultrafiltration and ion exchange, or evaporation which may permit the treated water to be reused in other processes. However, these treatment technologies are not demonstrated in this application. Activated Carbon is a demonstrated treatment process for reduction of organics but its effectiveness to completely remove very low levels of carbon-based contaminants is not known.

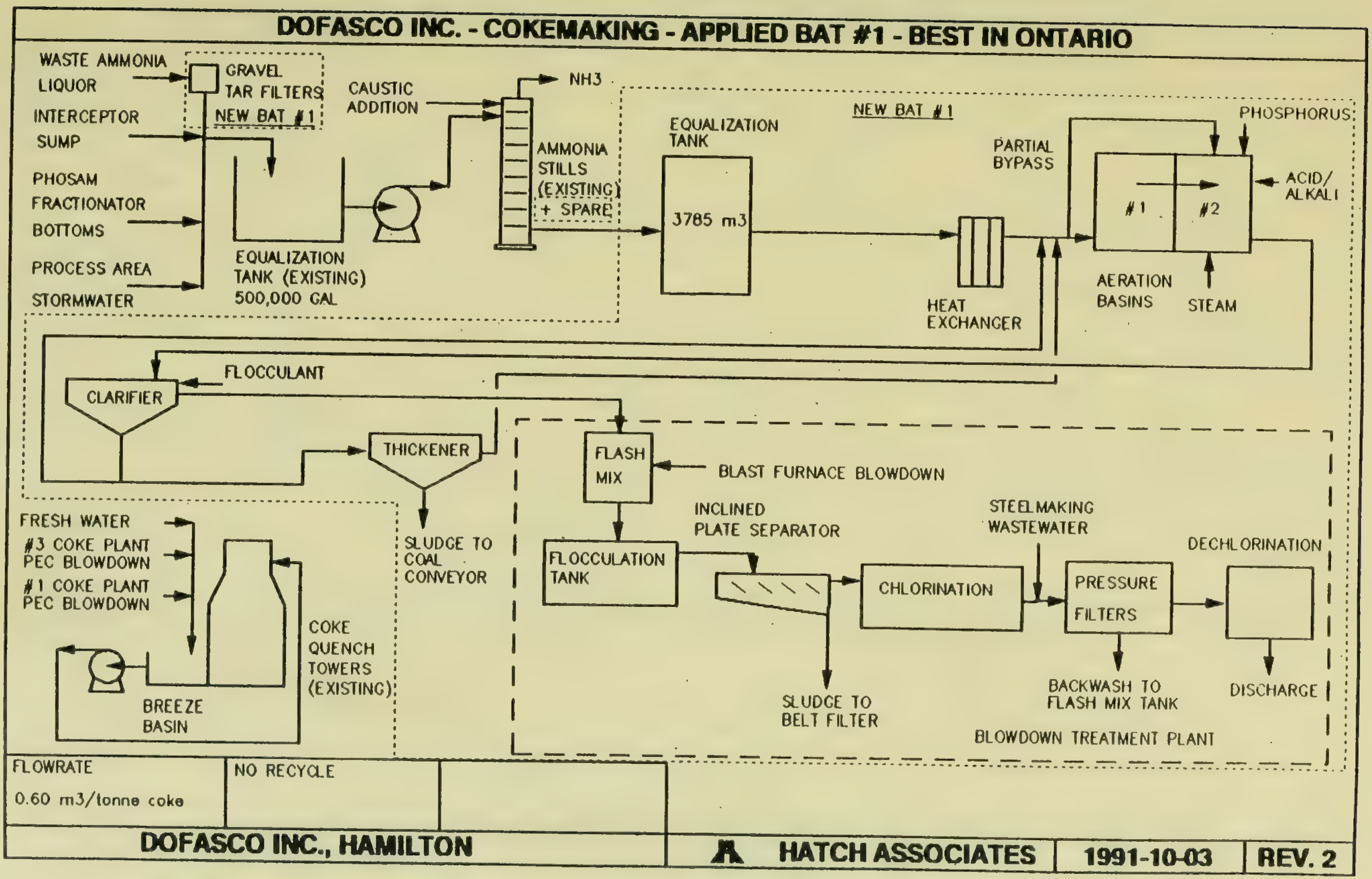
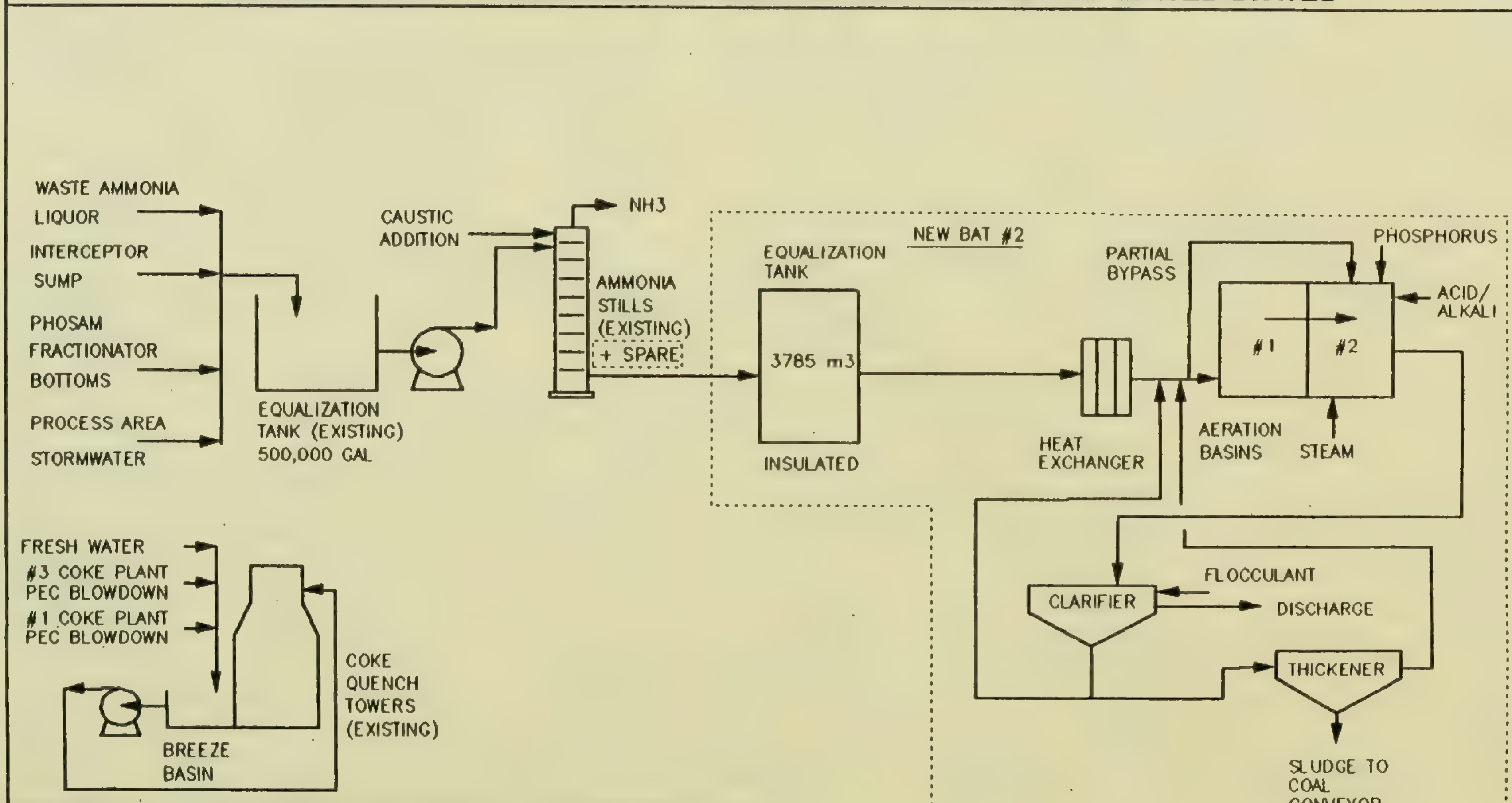

DOFASCO INC. - COKEMAKING - APPLIED BAT #1 - BEST IN ONTARIO
WASTE AMMONIA LIQUOR
INTERCEPTOR SUMP
PHOSAM FRACTIONATOR BOTTOMS
PROCESS AREA STORMWATER
GRAVEL TAR FILTERS
NEW BAT #1
EQUALIZATION TANK (EXISTING) 500,000 GAL
CAUSTIC ADDITION
NH3
AMMONIA STILLS (EXISTING) + SPARE
NEW BAT #1
EQUALIZATION TANK
3785 m3
HEAT EXCHANGER
PARTIAL BYPASS
PHOSPHORUS
ACID/ ALKALI
#1
#2
AERATION BASINS
STEAM
FLOCCULANT
CLARIFIER
THICKENER
SLUDGE TO COAL CONVEYOR
FLASH MIX
BLAST FURNACE BLOWDOWN
FLOCCULATION TANK
INCLINED PLATE SEPARATOR
SLUDGE TO BELT FILTER
CHLORINATION
STEELMAKING WASTEWATER
PRESSURE FILTERS
BACKWASH TO FLASH MIX TANK
DECHLORINATION
DISCHARGE
BLOWDOWN TREATMENT PLANT
FRESH WATER
#3 COKE PLANT PEC BLOWDOWN
#1 COKE PLANT PEC BLOWDOWN
COKE QUENCH TOWERS (EXISTING)
BREEZE BASIN
FLOWRATE
0.60 m3/tonne coke
NO RECYCLE
DOFASCO INC., HAMILTON
HATCH ASSOCIATES
1991-10-03
REV. 2

FIGURE 10.1.1

DOFASCO INC. - COKEMAKING - APPLIED BAT #2 - BEST IN THE UNITED STATES



FLOWRATE 0.54 m3/tonne + 0.10 m3/tonne = 0.64 m3/tonne coke (INLAND STEEL + LIGHT OIL RECOVERY)	NO RECYCLE

DOFASCO INC., HAMILTON	HATCH ASSOCIATES	1991-10-02	REV. 2

FIGURE 10.1.2

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – COKEMAKING – DOFASCO

BAT	EXISTING (Note 1)		BAT #1		BAT #2 (Note 2)		BAT #3	BAT #4	BAT #5
Flow (m3/day)	2818		2380		2142				
Parameter	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)			
TSS	120	336	7.3	17	59	123	See BAT #1.	See BAT #1.	No demonstrated technology in this industry sector.
oil and grease	1.8	5.2	1.4	3.4	1.3	2.7			
ammonia + ammonium	79	221	* 0.17	0.40	1.7	3.7			
cyanide total	41	115	0.93	2.2	6.9	14			
phenolics (4AAP)	2.5	7.2	0.012	0.029	0.039	0.087			
benzene	0.035	0.10	0.0052	0.012	0.0030	0.0059			
benzo(a)pyrene	0.061	0.17	0.010	0.025	0.021	0.044			
naphthalene	0.010	0.030	0.0062	0.015	0.011	0.023			

Notes:
1. Direct from MISA MIDES #0700 at Dofasco.
2. The BAT #2 flow (Inland, IH, 0.54 m3/tonne) does not include Light Oil Recovery. The EPA Development Document flow for Light Oil Recovery (O.10 m3/tonne) was added to the BAT #2 flow for costing purposes.

* less than RMDL

TABLE 10.1.2 : MISA MODEL / APPLIED BAT COSTING				
Mill : Dofasco Inc. Subcategory : Cokemaking BAT : 1 Process Flow : 2770 m3/day Date: 92/03/10			Filename: DOFCMCB.WK1	
1. Capital Costs				
(a) Engineering and Design				$2,374,000
(b) Equipment				$7,454,000
(c) Installation				$8,042,000
(d) Facilities and Structure				$6,839,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$9,331,000
Total Capital Cost				$34,040,000
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements Power	kWh	5644181	$0.05	$282,000
Steam	tonne	5771	$15.00	$87,000
Total Energy Requirements				$369,000
(b) Materials nutrients				$64,000
polymer				$481,000
NaOH	kg	275092	$0.485	$133,000
H2SO4	kg	36679	$0.122	$5,000
Chlorine	kg	91697	$0.375	$34,000
Dechlor chemicals				$15,000
Total Materials				$732,000
(c) Operating Labour	man years	4	$60,000	$240,000
(d) Maintenance	% of Capital	5.00%		$1,702,000
Total Operating & Maintenance				$3,043,000
4. Disposal of Sludges or Solid Wastes Increase over current operation.				
(a) Quantities Generated per Unit Time		97	tonne/year	$19,000
(b) Disposal Cost per Unit		$200		

Comments:

Sludge weight indicated on wet basis assuming 40% solids.

Bioplant solids are disposed of on the coal pile and are not included.

TABLE 10.1.3 : MISA MODEL / APPLIED BAT COSTING				
Mill : Dofasco Inc. Subcategory : Cokemaking BAT : 2 Process Flow : 2955 m3/day BLOWDOWN Date: 92/03/10			Filename: DOFCMCB.WK1	
1. Capital Costs				
(a) Engineering and Design				$2,139,000
(b) Equipment				$6,717,000
(c) Installation				$7,247,000
(d) Facilities and Structure				$6,154,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$8,406,000
Total Capital Cost				$30,663,000
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements power	kWh	4771332	$0.05	$239,000
steam	tonne	6156	$15.00	$92,000
Total Energy Requirements				$331,000
(b) Materials nutrients				$68,000
polymer				$257,000
Total Materials				$325,000
(c) Operating Labour	man years	4	$60,000	$240,000
(d) Maintenance	% of Capital	5.00%		$1,533,000
Total Operating & Maintenance				$2,429,000
4. Disposal of Sludges or Solid Wastes Increase over current operation.		Sludge to be blended with the coal		
(a) Quantities Generated per Unit Time			No cost	
(b) Disposal Cost per Unit				

Comments:
Sludge weight indicated on wet basis assuming 40% solids.
Bioplant solids are disposed of on the coal pile and are not included.

10.2 Ironmaking

10.2.1 BAT #1 Best in Ontario

In order to achieve the Model BAT #1 effluent quality, a blowdown treatment plant is required to treat the blowdown from the Ironmaking recirculation system. This treatment system should consist of equalization, metals precipitation, chlorination and filtration. The blowdown flow to the treatment system should be maintained at 0.80 m^3/tonne. In addition to this modification, the blast furnace sludge filtrate, the No. 2 ladle cleaning water, and the desulphurization wastewater should be redirected to the ironmaking water recycle system. These modifications are shown in Figure 10.2.1 *Dofasco Inc. Ironmaking Applied BAT #1 Best in Ontario.*

The predicted effluent quality data sheet, Table 10.2.1, for the modified treatment system is attached: The capital and operating cost data for these modifications are given in Table 10.2.2.

Baywater is presently used to cool slag at No. 1, No. 3 and No. 4 slag pits. There is no recirculation, and effluent discharges directly to the West Bayfront sewer. Table 10.2.1, Predicted Effluent Quality, does not include the flow contribution from these slag pits, which is approximately 4 100 m^3 per day. In order to achieve Model BAT #1 effluent quality, at the slag pits, a recirculation system should be installed to produce zero discharge. Two pumps (1 operating and 1 standby), piping, valves, instrumentation and associated civil/structural work would be required at each of the pits. The capital and operating cost data for these modifications are included in Table 10.2.2.

10.2.2 BAT #2 Best in the United States

The applied BAT #2 treatment system is similar to the applied BAT #1 treatment system except for the blowdown treatment plant. The BAT #2 blowdown treatment consists of only clarification and filtration. The BAT #2 treatment system is shown in Figure 10.2.2 *Dofasco Inc. Ironmaking Applied BAT #2 Best in the United States.*

Baywater is presently used to cool slag at No. 1, No. 3 and No. 4 slag pits. There is no recirculation, and effluent discharges directly to the West Bayfront sewer. Table 10.2.1, Predicted Effluent Quality, does not include the flow contribution from these slag pits, which is approximately 4 100 m^3 per day. In order to achieve Model BAT #2A effluent quality, at the slag pits, a recirculation system should be installed to produce zero discharge. Two pumps (1 operating and 1 standby), piping, valves, instrumentation and associated civil/structural work would be required at each of the pits. The capital and operating cost data for these modifications are included in Table 10.2.3.

10.2.3 BAT #3 Best at Selected World Locations

The best available technology was determined to be the BAT #1 technology. The modifications required for applied BAT #1 are detailed in section 10.2.1.

10.2.4 BAT #4 Non-Lethal

The BAT #3 wastewater treatment technology for Ironmaking was determined to be the BAT #1 process. The applied BAT #1 modifications are outlined in section 10.2.1.

There is no specified toxicity data available for the Ironmaking BAT #3 wastewater effluent stream. The technology demonstrated at Stelco LEW where the treated effluent from the ironmaking is further co-treated with other process streams through a chemical/physical blowdown treatment facility was found to be non-lethal most of the time. At Dofasco, the Ironmaking blowdown may be co-treated with the Cokemaking and Steelmaking effluent and may be combined with other streams prior to discharge to Hamilton Harbour. However, no assessment of the toxicity of this effluent can be made at this time. Toxicity testing on the BAT #3 effluent is required.

10.2.5 BAT #5 Virtual Elimination of Persistent Toxics

The BAT #3 wastewater treatment technology for Ironmaking was determined to be the BAT #1 process. The applied BAT #1 modifications are outlined in section 10.2.1.

The BAT #3 wastewater stream is expected to contain very low levels (in some cases below the RMDL) of organic compounds. No demonstrated technologies are known to further reduce the concentrations of these compounds to lower levels. Virtual elimination of persistent toxics can only be assured by zero discharge. No discharge to receiving water may be achieved with further treatment by ultrafiltration and ion exchange, or evaporation which may permit the treated water to be recycled to the process. However, these treatment technologies are not demonstrated in this application.

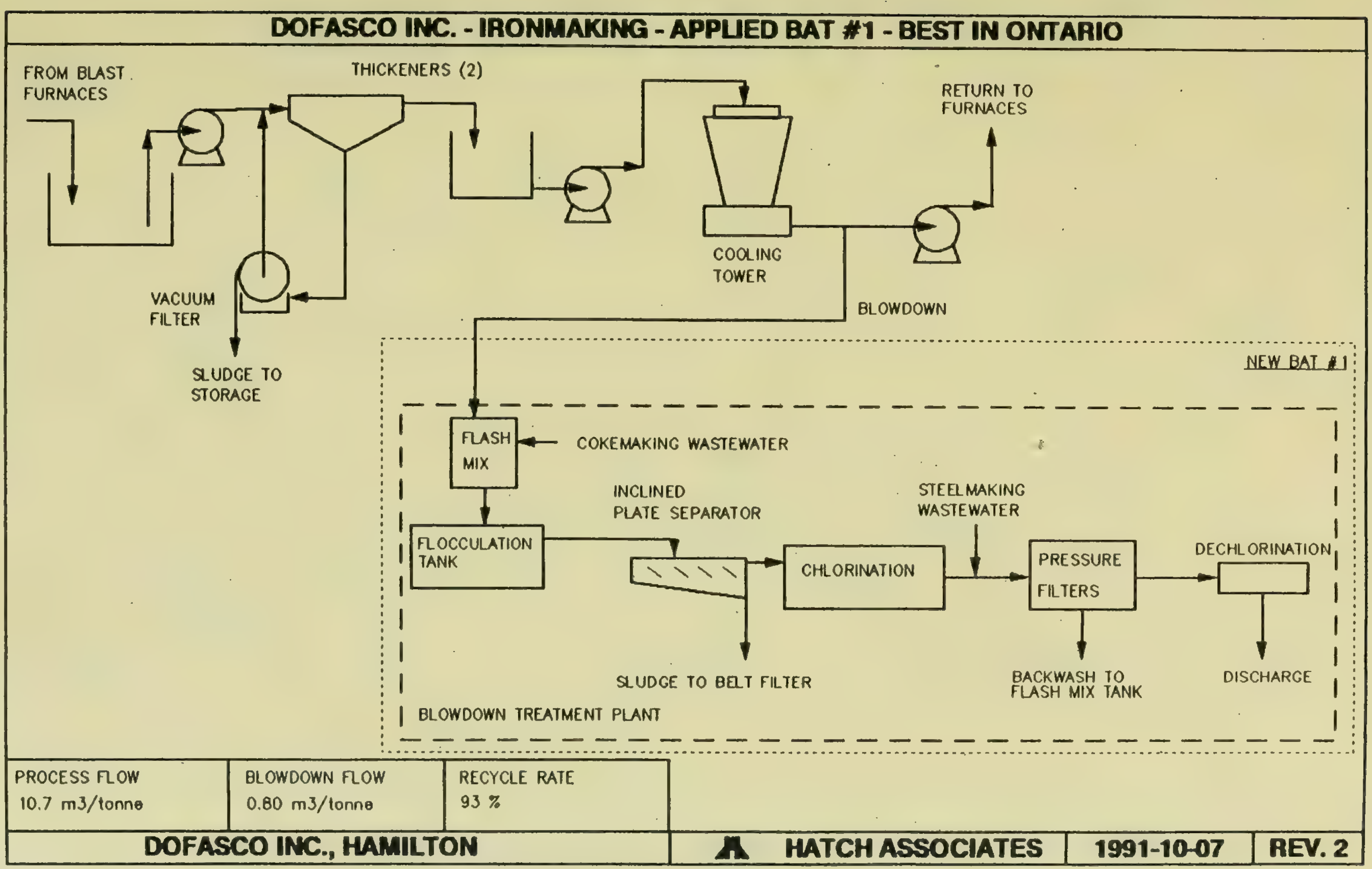
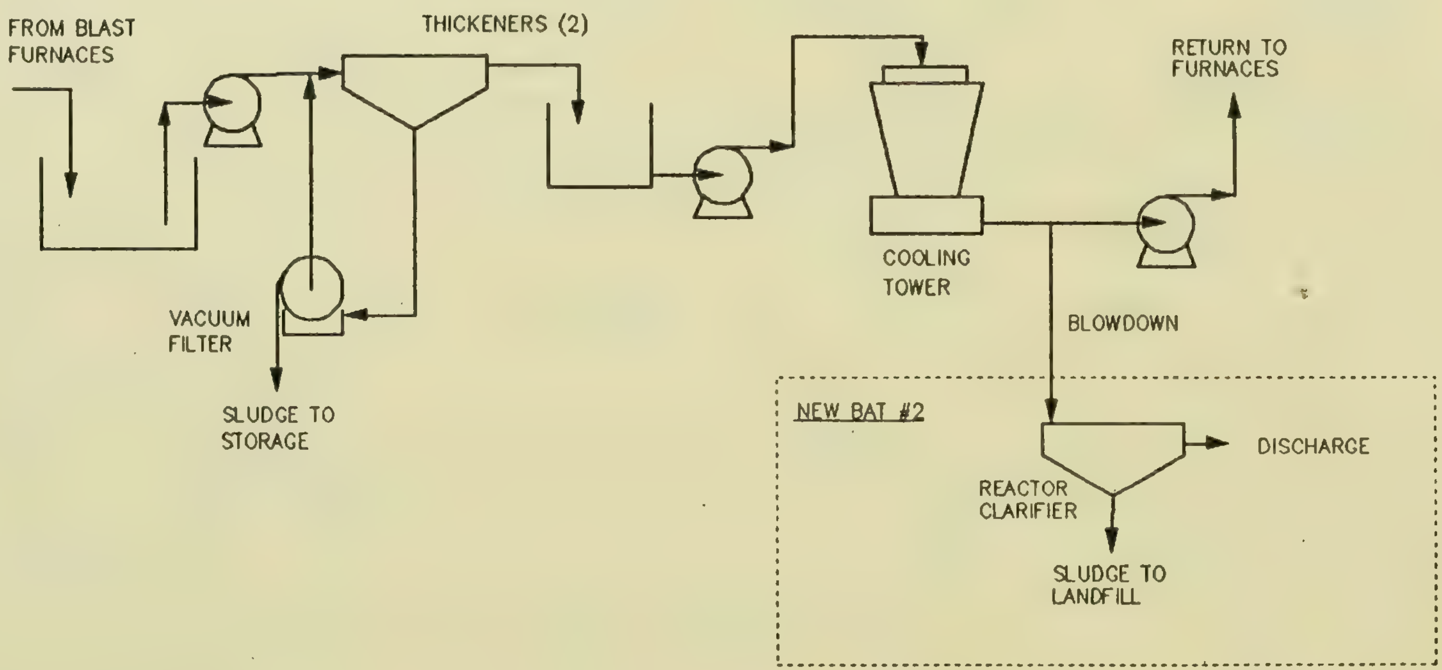

DOFASCO INC. - IRONMAKING - APPLIED BAT #1 - BEST IN ONTARIO
FROM BLAST FURNACES
THICKENERS (2)
VACUUM FILTER
SLUDGE TO STORAGE
COOLING TOWER
RETURN TO FURNACES
BLOWDOWN
NEW BAT #1
FLASH MIX
COKEMAKING WASTEWATER
FLOCCULATION TANK
INCLINED PLATE SEPARATOR
CHLORINATION
STEELMAKING WASTEWATER
PRESSURE FILTERS
DECHLORINATION
SLUDGE TO BELT FILTER
BACKWASH TO FLASH MIX TANK
DISCHARGE
BLOWDOWN TREATMENT PLANT
PROCESS FLOW
10.7 m3/tonne
BLOWDOWN FLOW
0.80 m3/tonne
RECYCLE RATE
93 %
DOFASCO INC., HAMILTON
HATCH ASSOCIATES
1991-10-07
REV. 2

FIGURE 10.2.1

DOFASCO INC. - IRONMAKING - APPLIED BAT #2 - BEST IN THE UNITED STATES



PROCESS FLOW	BLOWDOWN FLOW	RECYCLE RATE
10.7 m3/tonne	0.26 m3/tonne	98 %

DOFASCO INC., HAMILTON	HATCH ASSOCIATES	1992-03-06	REV. 1

FIGURE 10.2.2

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – IRONMAKING – DOFASCO

BAT	EXISTING (Note 1)		BAT #1		BAT #2A		BAT #2B	BAT #3	BAT #4	BAT #5
Flow (m3/day)	1267		6721		2184					
Parameter	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)				
TSS	31	71	* 4.9	33	8.6	18				
oil and grease	-	-	-	-	-	-	No effluent	See BAT #1.	See BAT #1.	No demonstrated
ammonia + ammonium	39	50	0.52	3.4	62	134	to receiving			technology in
cyanide total	0.36	0.45	0.47	3.1	0.14	0.30	water -			this industry
phenolics (4AAP)	0.12	0.22	0.012	0.082	0.083	0.18	slag			sector.
lead	-	-	* 0.022	0.15	0.019	0.041	evaporation.			
zinc	0.18	0.31	0.045	0.29	0.20	0.44				

Notes: 1. Direct from MISA outfall, MIDES #0800 "Blast Furnace Recycle Blowdown" for the period October 1 - 31, 1990. This outfall does not include wastewater from the #2 Dekishing Station Ladle Cleaning (5 500 m3/day), the Desulphurization Station (2 180 m3/day), or the Floc Tank underflow blast furnace sludge (max 2 180 m3/day) which all currently discharge to the Steelmaking Clarifier (MISA Monitoring Point 0900).

* less than RMDL

1992-02-12	TABLE 10.2.1	HATCH ASSOCIATES	PEQIRDOF.WK1 PEQIRDOF.ALL	REV. # 4

TABLE 10.2.2 : MISA MODEL / APPLIED BAT COSTING				
Mill : Dofasco Inc. Subcategory : Ironmaking with slag pit recirculation (bay water) BAT : 1 Process Flow : 8583 m3/day (BLOWDOWN) Date: 92/03/10 Filename: DOFIMJJ2.WK1				
1. Capital Costs				
(a) Engineering and Design				$1,264,000
(b) Equipment				$4,295,000
(c) Installation				$4,556,000
(d) Facilities and Structure				$3,035,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$4,966,000
Total Capital Cost				$18,116,000
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements power	kWh	4618262	$0.05	$231,000
Total Energy Requirements				$231,000
(b) Materials polymer				$745,000
NaOH	kg	852361	$0.485	$413,000
H2SO4	kg	113648	$0.122	$14,000
chlorine	kg	284120	$0.375	$107,000
Total Materials				$1,279,000
(c) Operating Labour	No increase	0	$60,000	$0
(d) Maintenance	% of Capital	5.00%		$906,000
Total Operating & Maintenance				$2,416,000
4. Disposal of Sludges or Solid Wastes Increase over existing operation.				
(a) Quantities Generated per Unit Time		35	tonne/year	$7,000
(b) Disposal Cost per Unit		$200	$/tonne	
Comments: Sludge weight indicated on a wet basis assuming 40% solids.				

TABLE 10.2.3 : MISA MODEL / APPLIED BAT COSTING				
Mill : Dofasco Inc. Subcategory : Ironmaking with slag pit recirculation (bay water) BAT : 2 A Process Flow : 1901 m3/day (BLOWDOWN RATE) Date: 92/03/10 Filename: DOFIMJJ2.WK1				
1. Capital Costs				
(a) Engineering and Design				$912,000
(b) Equipment				$3,197,000
(c) Installation				$3,370,000
(d) Facilities and Structure				$2,015,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$3,585,000
Total Capital Cost				$13,079,000
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements power	kWh	2927076	$0.05	$146,000
Total Energy Requirements				$146,000
(b) Materials				
Total Materials	No increase			$0
(c) Operating Labour	No increase	0	$60,000	$0
(d) Maintenance	% of Capital	5.00%		$654,000
Total Operating & Maintenance				$800,000
4. Disposal of Sludges or Solid Wastes Increase over existing operation.				
(a) Quantities Generated per Unit Time		53	tonne/year	$11,000
(b) Disposal Cost per Unit		200	$/tonne	
Comments: Sludge weight indicated on a wet basis assuming 40% solids.				

10.3 Steelmaking

10.3.1 BAT #1 Best in Ontario

In order to achieve an effluent quality equivalent to Model BAT #1, a recirculation system could be installed on the No. 1 and No. 2 melt shops. A blowdown treatment plant is required to treat the blowdown from these two systems. The Model BAT #1 identified for open combustion systems is a dry gas cleaning process (Stelco Hilton). The Stelco LEW treatment system was selected as the Model BAT #1 for suppressed combustion steelmaking. The LEW treatment system represents good operating practice and was therefore applied for both the No. 1 Meltshop (open combustion) and the No. 2 Melt Shop (suppressed combustion). The treatment system should consist of equalization, metals precipitation and filtration. In addition to these modifications, all non-steelmaking wastewaters should be removed from the recirculation system. The treatment system is shown in Figure 10.3.1 *Dofasco Inc. BOF Steelmaking Applied BAT #1 Best in Ontario*.

It might be preferable to process the Steelmaking blowdown separately (from the Cokemaking and Ironmaking blowdowns) because, when combined, the resulting sludge could be hazardous. The estimated costs are not affected as they are already on a stand-alone basis.

A dry gas cleaning system is possible for the No. 1 meltshop. However, this modification is not practical in a retrofit situation, is capable of producing only minor benefits with respect to effluent quality, and requires handling of dry dust.

The predicted effluent quality data sheet, Table 10.3.1, for the modified treatment system is attached. The capital and operating cost data for the wet gas cleaning modifications are given in Table 10.3.2.

10.3.2 BAT #2 Best in the United States

In order to achieve an effluent quality equivalent to Model BAT #2, a recirculation system could be installed on both the No. 1 and the No.2 melt shops. A CO_2 softening system is required to further reduce the blowdown from the No. 2 melt shop. The No. 1 melt shop blowdown should

also be reduced to the BAT #2B level. The blowdown flow should be directed to a filtration plant prior to discharge. In addition to these modifications, all non-steelmaking wastewaters should be removed from the recirculation system. The treatment system is shown in Figure 10.3.2 *Dofasco Inc. BOF Steelmaking Applied BAT #2 Best in the United States*.

The capital and operating cost data for the BAT #2 treatment technology are given in Table 10.3.3.

10.3.3 BAT #3 Best at Selected World Locations

The best available technology for treatment of wet gas cleaning wastewaters was determined to be the BAT #2 treatment system. This technology is described in section 10.3.2.

Dry gas cleaning systems can be considered for both the No. 1 and No. 2 melt shops to eliminate the wastewater stream. This would be the Stelco Hilton open combustion system for the No. 1 Meltshop and the Lurgi-Thyssen suppressed combustion system for the No. 2 Meltshop. The capital and operating costs for the dry gas cleaning modifications are given in Tables 10.3.4 and 10.3.5.

10.3.4 BAT #4 Non-Lethal

The BAT #3 wastewater treatment technology for Steelmaking was determined to be the BAT #2 process. The applied BAT #2 modifications are outlined in section 10.3.2.

There is no specific toxicity data available for the BAT #3 Steelmaking wastewater stream. However, based on an assessment of the effluent characteristics, specifically the single contaminant LC50 values, the effluent is likely to pass the Ontario Toxicity Test depending on hardness. No demonstrated technologies are known to further reduce the zinc concentration to a lower level than measured in the wastewater stream. This stream is likely to be co-treated with the Cokemaking and Ironmaking effluent streams and may be combined with other streams prior to discharge to Hamilton Harbour. An accurate assessment of the toxicity of this unknown stream can not be made at this time.

An alternative technology to achieve BAT #4 is dry gas cleaning, as used at Stelco Hilton for open combustion systems, and Posco Kwangyang and Thyssen for suppressed combustion systems.

10.3.5 BAT #5 Virtual Elimination of Persistent Toxics

The BAT #3 wastewater treatment technology for Steelmaking was determined to be the BAT #2 process. The applied BAT #2 modifications are outlined in section 10.3.2.

The BAT #3 Steelmaking wastewater stream is not expected to contain any persistent bioaccumulative toxics, however, the stream is expected to contain low levels of lead and zinc. No demonstrated technologies are known to further reduce the concentrations of these compounds. Virtual elimination of persistent toxics can only be assured by zero discharge. This may be achieved with further treatment by ultrafiltration and ion exchange, or evaporation which may permit the treated water to be recycled to the process. However, these treatment technologies are not demonstrated in this industrial sector.

An alternative technology to achieve BAT #5 Virtual Elimination is dry gas cleaning as established at Stelco Hilton Works for open combustion systems, and Posco Kwangyang, or Thyssen for suppressed combustion systems.

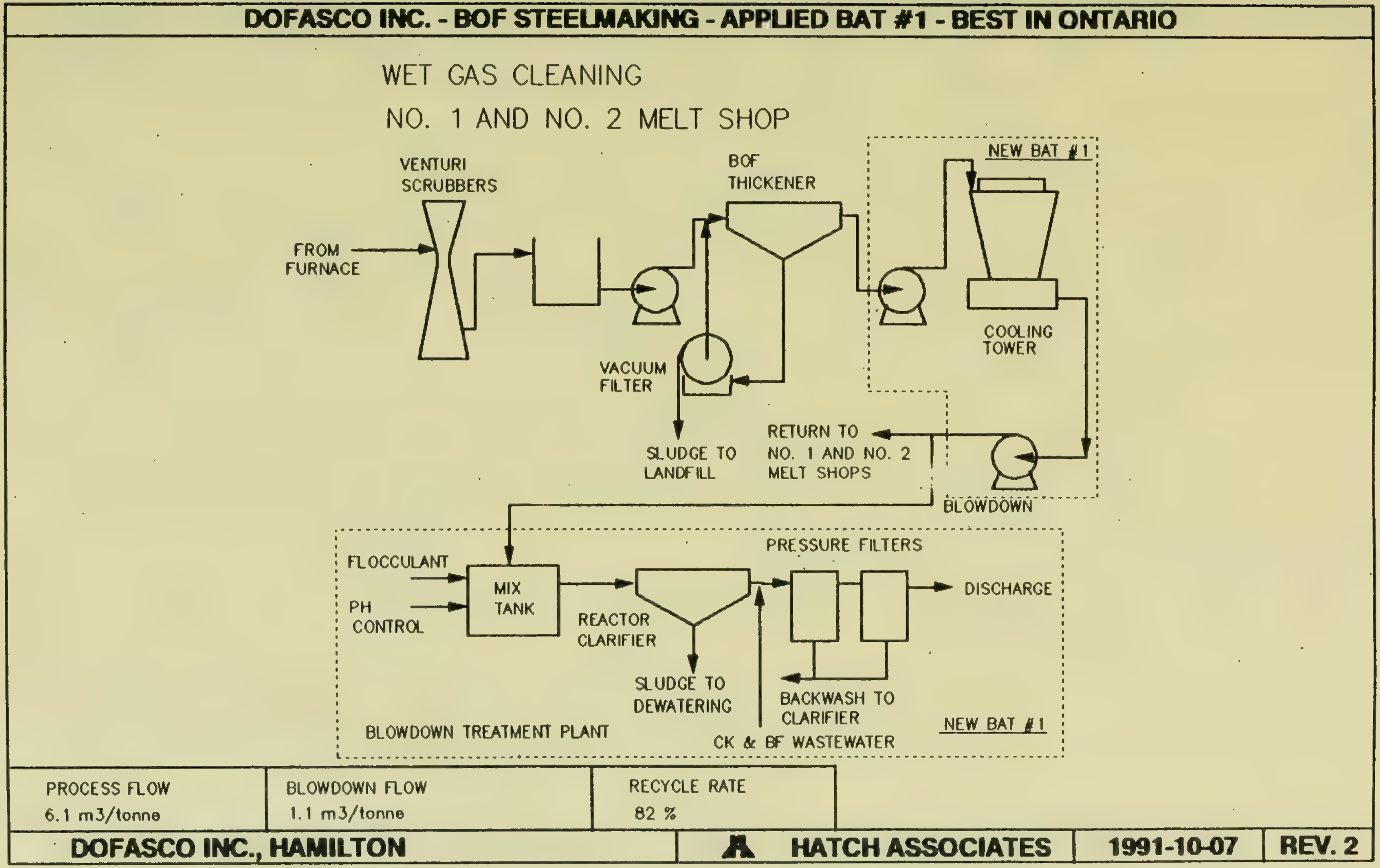
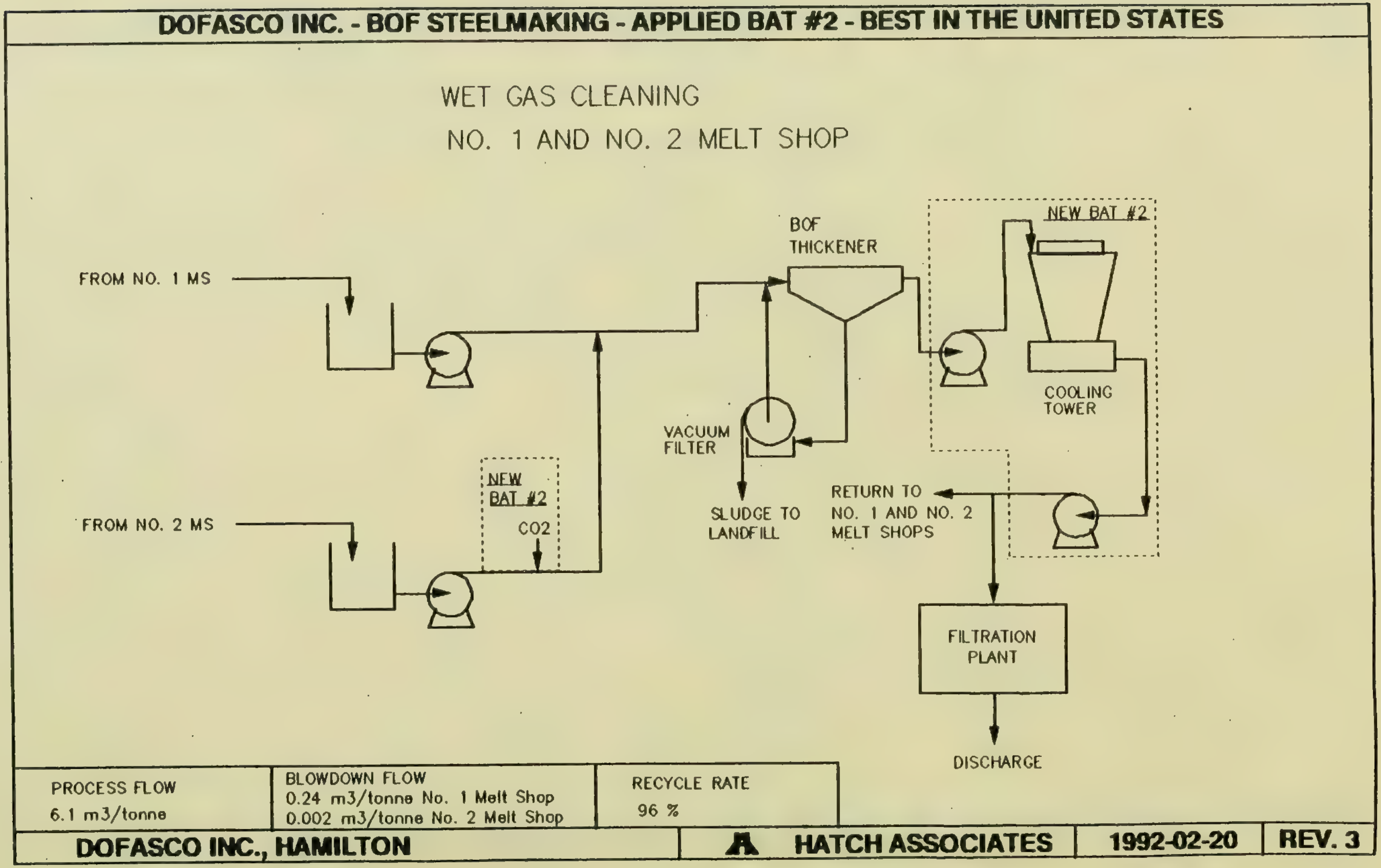

DOFASCO INC. - BOF STEELMAKING - APPLIED BAT #1 - BEST IN ONTARIO
WET GAS CLEANING
NO. 1 AND NO. 2 MELT SHOP
VENTURI SCRUBBERS
FROM FURNACE
BOF THICKENER
VACUUM FILTER
SLUDGE TO LANDFILL
NEW BAT #1
COOLING TOWER
RETURN TO NO. 1 AND NO. 2 MELT SHOPS
BLOWDOWN
PRESSURE FILTERS
FLOCCULANT
PH CONTROL
MIX TANK
REACTOR CLARIFIER
DISCHARGE
SLUDGE TO DEWATERING
BACKWASH TO CLARIFIER
NEW BAT #1
BLOWDOWN TREATMENT PLANT
CK & BF WASTEWATER
PROCESS FLOW
6.1 m3/tonne
BLOWDOWN FLOW
1.1 m3/tonne
RECYCLE RATE
82 %
DOFASCO INC., HAMILTON
HATCH ASSOCIATES
1991-10-07
REV. 2

FIGURE 10.3.1



DOFASCO INC. - BOF STEELMAKING - APPLIED BAT #2 - BEST IN THE UNITED STATES
WET GAS CLEANING
NO. 1 AND NO. 2 MELT SHOP
FROM NO. 1 MS
FROM NO. 2 MS
NEW BAT #2
CO2
BOF THICKENER
VACUUM FILTER
SLUDGE TO LANDFILL
NEW BAT #2
COOLING TOWER
RETURN TO NO. 1 AND NO. 2 MELT SHOPS
FILTRATION PLANT
DISCHARGE
PROCESS FLOW
6.1 m3/tonne
BLOWDOWN FLOW
0.24 m3/tonne No. 1 Melt Shop
0.002 m3/tonne No. 2 Melt Shop
RECYCLE RATE
96 %
DOFASCO INC., HAMILTON
HATCH ASSOCIATES
1992-02-20
REV. 3

FIGURE 10.3.2

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – STEELMAKING – DOFASCO

BAT	EXISTING (Note 1)		BAT #1A (Note 2)		BAT #2A (Note 2)		BAT #2B (Note 3)		BAT #3A	BAT #3B	BAT #4	BAT #5
Flow (m3/day)	85229		11080		11		1131					
Parameter	Average Conc.	Average Loading	Average Conc.	Average Loading	Average Conc.	Average Loading	Average Conc.	Average Loading				
	(mg/L)	(kg/day)	(mg/L)	(kg/day)	(mg/L)	(kg/day)	(mg/L)	(kg/day)				
TSS	54	4565	* 4.9	56	4.2	0.044	3.0	3.4	Wet Gas Cleaning. see BAT #2.	Dry Gas Cleaning. no effluent.	BAT #2 or Dry Gas Cleaning.	Note 4
oil and grease	1.8	158	-	-	-	-	-	-				
lead	0.047	4.2	0.093	1.1	0.029	0.00030	0.059	0.066				
zinc	0.20	17	0.19	2.1	0.18	0.0019	0.12	0.13				

Notes:
1. Data from MISA Monitoring Point, MIDES #0900, STEELMAKING CLARIFIER (No. 1, 2 MS). Since part of the existing flow, 4361 m3/day, was attributable to the No.2 Hot Mill, the Steelmaking flowrate was reduced by this amount. The TSS and oil & grease loadings attributable to the No.2 Hot Mill were subtracted from the total loadings, in proportion to the flow. The total lead and zinc loadings were attributed to Steelmaking.

2. BAT #2A was applied to the No. 2 Melt Shop, a suppressed combustion system.

3. BAT #2B was applied to the No. 1 Melt Shop, an open combustion system.

4. Wet Gas Cleaning: No demonstrated technology in this industry sector; or Dry Gas Cleaning.

* less than RMDL

1992-02-12	TABLE 10.3.1	HATCH ASSOCIATES	PEQSMDOF.WK1 PEQSMDOF.ALL	REV. # 4

TABLE 10.3.2 : MISA MODEL / APPLIED BAT COSTING				
Mill : Dofasco Inc. Subcategory : Steelmaking BAT : 1 WET SYSTEM #1 AND #2 MELTSHOP Process Flow : 13493 m3/day (BLOWDOWN) Date: 92/03/10 Filename: DOFSMJJ.WK1				
1. Capital Costs				
(a) Engineering and Design				$3,340,000
(b) Equipment				$10,484,000
(c) Installation				$11,312,000
(d) Facilities and Structure				$9,622,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$13,126,000
Total Capital Cost				$47,884,000
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements power	kWh	20105061	$0.05	$1,005,000
Total Energy Requirements				$1,005,000
(b) Materials polymer				$1,171,000
NaOH	kg	1339917	$0.485	$650,000
H2SO4	kg	178656	$0.122	$22,000
chemical	kg	446639	$0.375	$167,000
Total Materials				$2,010,000
(c) Operating Labour	man years	4	$60,000	$240,000
(d) Maintenance	% of Capital	5.00%		$2,394,000
Total Operating & Maintenance				$5,649,000
4. Disposal of Sludges or Solid Wastes Increase over existing operation.				
(a) Quantities Generated per Unit Time		4259	tonne/year	$852,000
(b) Disposal Cost per Unit		$200	$/tonne	
Comments: Sludge weight indicated on a wet basis assuming 40% solids.				

TABLE 10.3.3 : MISA MODEL / APPLIED BAT COSTING

Mill : Dofasco Inc.
Subcategory : Steelmaking
BAT : 2 (WET SYSTEM #1 AND #2 MELTSHOP)
Process Flow : 1057 m3/day (BLOWDOWN RATE)
Date: 92/03/10 Filename: DOFSMJJ.WK1

1. Capital Costs				
(a) Engineering and Design				$2,770,000
(b) Equipment				$8,716,000
(c) Installation				$9,399,000
(d) Facilities and Structure				$7,943,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$10,887,000
Total Capital Cost				$39,715,000
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements power	kWh	17370538	$0.05	$869,000
Total Energy Requirements				$869,000
(b) Materials CO2				$123,000
CO2 equipment rental				$7,000
NaOH		105000	$0.485	$51,000
H2SO4		14000	$0.122	$2,000
chemicals		35000	$0.375	$13,000
polymer				$91,000
Total Materials				$287,000
(c) Operating Labour	man years	4	$60,000	$240,000
(d) Maintenance	% of Capital	5.00%		$1,986,000
Total Operating & Maintenance				$3,382,000
4. Disposal of Sludges or Solid Wastes Increase over existing operation.				
(a) Quantities Generated per Unit Time		4310	tonne/year	$862,000
(b) Disposal Cost per Unit		200	$/tonne	

Comments:
Sludge weight indicated on a wet basis assuming 40% solids.

TABLE 10.3.4 : MISA MODEL / APPLIED BAT COSTING				
Mill :	Dofasco Inc.			
Subcategory :	Steelmaking (Dry Gas Cleaning)			
BAT :	Alternate BAT #3 – MELTSHOP #1			
Process Flow :	Dry (no water)			
Date:	August 30, 1991		Filename:	DOFSMJJ.WK1
1. Capital Costs				
(a) Engineering and Design				$3,301,000
(b) Equipment				$10,317,000
(c) Installation				$11,143,000
(d) Facilities and Structure				$9,595,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$12,974,000
Total Capital Cost				$47,330,000
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements				
Energy savings	kWh	23000000	$0.05	($1,150,000)
Total Energy Requirements				($1,150,000)
(b) Materials				
Total Materials				
(c) Operating Labour	man years			No increase
(d) Maintenance	% of Capital	5.0%		$2,367,000
Total Operating & Maintenance				$1,217,000
4. Disposal of Sludges or Solid Wastes				
(a) Quantities Generated per Unit Time		940	tonne/year	$188,000
(b) Disposal Cost per Unit		$200	$/tonne	

Comments:

Sludge weight indicated on a wet basis assuming 95% solids (effectively dry).

TABLE 10.3.5 : MISA MODEL / APPLIED BAT COSTING				
Mill : Dofasco Inc. Subcategory : Steelmaking (Dry Gas Cleaning) BAT : Alternate BAT #3 – MELTSHOP #2 Process Flow : Dry (no water) Date: August 30, 1991			Filename:	DOFSMJJ.WK1
1. Capital Costs				
(a) Engineering and Design				$1,718,000
(b) Equipment				$5,369,000
(c) Installation				$5,798,000
(d) Facilities and Structure				$4,993,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$6,751,000
Total Capital Cost				**$24,629,000**
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	**Commodity**	**Quantities per year**	**Unit Costs**	**Annual Costs**
(a) Energy Requirements				
Energy savings	kWh	13000000	$0.05	($650,000)
Total Energy Requirements				($650,000)
(b) Materials				
Total Materials				
(c) Operating Labour	man years			No increase
(d) Maintenance	% of Capital	5.0%		$1,231,000
Total Operating & Maintenance				**$581,000**
4. Disposal of Sludges or Solid Wastes				
(a) Quantities Generated per Unit Time		899	tonne/year	$180,000
(b) Disposal Cost per Unit		$200	$/tonne	

Comments:

Sludge weight indicated on a wet basis assuming 95% solids (effectively dry).

10.4 No. 2 Hot Mill and Continuous Casting

10.4.1 BAT #1 Best in Ontario

Dofasco's Continuous Caster and No. 2 Hot Mill treatment system is probably equivalent to or better than Stelco's Lake Erie Works treatment system based on flow, however, no MISA effluent data is available. The settling basin sludge and decant basin sludge from this treatment system currently discharge to the BOF thickener. In order to provide a treatment system equivalent to Stelco LEW, it is necessary to add backwash/solids handling facilities to the system. This is provided by a thickener and sludge dewatering facilities, with the filtrate and supernatant returned to the No. 2 Hot Mill and Continuous Caster recycle systems at the settling basin. This wastewater is then filtered prior to recycle or blowdown. This provides essentially the same treatment processes as Stelco LEW for the blowdown stream.

The treatment system is shown in Figure 10.4.1 *Dofasco Inc. No. 2 Hot Mill and Continuous Caster Applied BAT #1 Best in Ontario*. The predicted effluent quality data sheet for the modified treatment system are given in Tables 10.4.1 and 10.5.1. The capital and operating costs for this treatment system are given in Table 10.4.2.

10.4.2 BAT #2 Best in the United States

In order to achieve the BAT #2 effluent quality, sludge dewatering facilities are required, similar to those described in Section 10.4.1 with the Continuous Caster blowdown flow reduced to 0.076 m^3/tonne and the No. 2 Hot Mill blowdown flow reduced to 0.36 m^3/tonne.

The capital and operating cost data for these modifications are given in Table 10.4.3.

10.4.3 BAT #3 Best at Selected World Locations

The best available Continuous Casting and Hot Forming technology was determined to be the BAT #2 treatment systems. The applied BAT #2 modifications are detailed in section 10.4.2.

10.4.4 BAT #4 Non-Lethal

The BAT #3 wastewater treatment technology for Continuous Casting and Hot Forming was determined to be the BAT #2 process. The applied BAT #2 modifications are outlined in section 10.4.2.

There is no specific toxicity data available for the BAT #3 Continuous Casting and Hot Forming wastewater stream. However, based on an assessment of the effluent characteristics, specifically the single contaminant LC50 values, the effluent may pass the Ontario Toxicity Test depending on hardness and dissolved solids. Based on toxicity testing during the MISA monitoring period at Algoma (No. 2 Tube Mill), Dofasco (No. 3 Hot Mill), Stelco (No. 3 Bloom & Billet Mill) and USEPA toxicity testing of similar streams, Hot Forming effluent is considered very likely to pass the Ontario Toxicity Test. An accurate assessment of the toxicity of the co-treated Continuous Casting and Hot Forming stream can not be made at this time. The combined stream will likely be discharged to Hamilton Harbor.

10.4.5 BAT #5 Virtual Elimination of Persistent Toxics

The BAT #3 wastewater treatment technology for Continuous Casting and Hot Forming was determined to be the BAT #2 process. The applied BAT #2 modifications are outlined in section 10.4.2.

Hot Forming wastewater streams do not normally contain toxic metals or organics. However, the stream is expected to contain very low levels of lead and zinc from the Continuous Caster wastewater stream. No demonstrated technologies are known to further reduce the concentrations of these compounds. Virtual elimination of persistent toxics can only be assured by zero discharge. This may be achieved with further treatment by ultrafiltration and ion exchange, or evaporation which may permit the treated water to be recycled to the process. However, these treatment technologies are not demonstrated in this industrial sector.

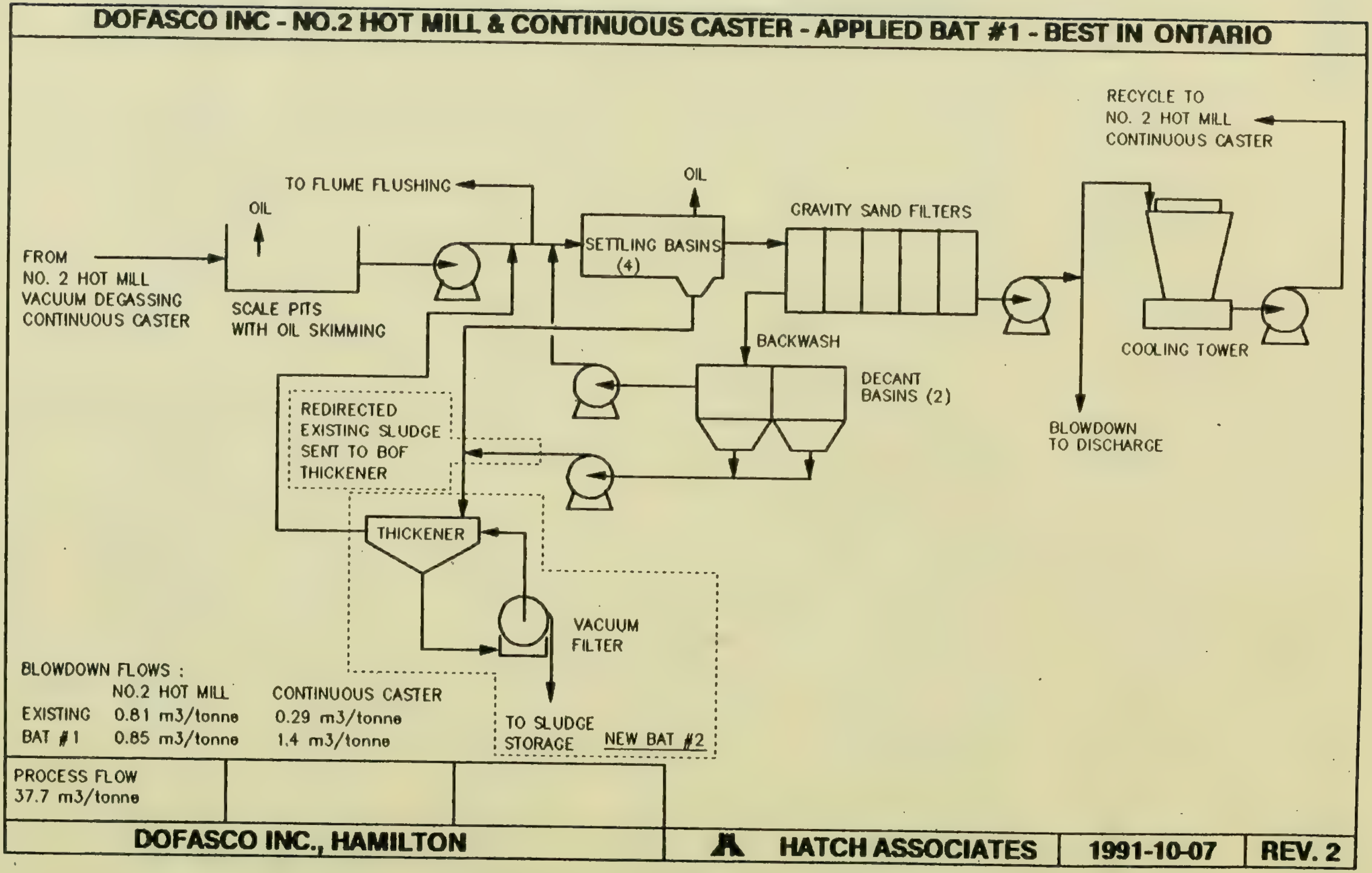

DOFASCO INC - NO.2 HOT MILL & CONTINUOUS CASTER - APPLIED BAT #1 - BEST IN ONTARIO
FROM
NO. 2 HOT MILL
VACUUM DEGASSING
CONTINUOUS CASTER
OIL
SCALE PITS
WITH OIL SKIMMING
TO FLUME FLUSHING
OIL
SETTLING BASINS
(4)
GRAVITY SAND FILTERS
BACKWASH
DECANT
BASINS (2)
RECYCLE TO
NO. 2 HOT MILL
CONTINUOUS CASTER
COOLING TOWER
BLOWDOWN
TO DISCHARGE
REDIRECTED
EXISTING SLUDGE
SENT TO BOF
THICKENER
THICKENER
VACUUM
FILTER
TO SLUDGE
STORAGE
NEW BAT #2
BLOWDOWN FLOWS :
NO.2 HOT MILL
CONTINUOUS CASTER
EXISTING 0.81 m3/tonne 0.29 m3/tonne
BAT #1 0.85 m3/tonne 1.4 m3/tonne
PROCESS FLOW
37.7 m3/tonne
DOFASCO INC., HAMILTON
HATCH ASSOCIATES
1991-10-07
REV. 2

FIGURE 10.4.1

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – CONTINUOUS CASTING – DOFASCO

BAT	EXISTING		BAT #1 (Note 2)		BAT #2		BAT #3	BAT #4	BAT #5
Flow (m3/day)	1487		7130		387				
Parameter	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)			
TSS	Note 1		* 4.9	34	21	7.1	See BAT #2.	See BAT #2.	No demonstrated technology in this industry sector.
oil and grease			1.4	10	1.8	0.81			
lead			–	–	0.13	0.044			
zinc			–	–	0.11	0.041			

Notes: 1. Dofasco's Continuous Caster treatment train is probably equivalent to or better than LEW's treatment system, based on flow. No effluent data is available to allow a proper evaluation. The Caster blowdown discharges to the #2 Hot Mill Filter Plant.

2. Flow, loading and concentrations are shown for BAT #1 values. Dofasco currently discharges a lower flow from the Caster.

* less than RMDL

1992-02-25	TABLE 10.4.1	HATCH ASSOCIATES	PEQCCDOF.WK1 PEQCCDOF.ALL	REV. # 4

TABLE 10.4.2 : MISA MODEL / APPLIED BAT COSTING				
Mill : Dofasco Inc.				
Subcategory : Hotforming				
BAT : 1, #2 Hot Mill and Caster				
Process Flow : 6904 m3/day (BLOWDOWN RATE)				
Date: Febuary 19, 1992			Filename: DOFHM2CB.WK1	
1. Capital Costs				
(a) Engineering and Design				$231,000
(b) Equipment				$743,000
(c) Installation				$798,000
(d) Facilities and Structure				$630,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$907,000
Total Capital Cost				$3,309,000
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements power	kWh	740000	$0.05	$37,000
Total Energy Requirements				$37,000
(b) Materials				
POLYMER				$600,000
NaOH	kg	685599	$0.485	$333,000
Total Materials				$933,000
(c) Operating Labour				
(d) Maintenance	% of Capital	5.00%		$165,000
Total Operating & Maintenance				$1,135,000
4. Disposal of Sludges or Solid Wastes Increase over existing operation.				
(a) Quantities Generated per Unit Time		229	tonne/year	$46,000
(b) Disposal Cost per Unit		200	$/tonne	
Comments:				

TABLE 10.4.3 : MISA MODEL / APPLIED BAT COSTING				
Mill :	Dofasco Inc.			
Subcategory :	Hotforming			
BAT :	2, #2 Hot Mill and Caster			
Process Flow :	2216 m3/day (BLOWDOWN RATE)			
Date:	Febuary 19, 1992		Filename:	DOFHM2CB.WK1
1. Capital Costs				
(a) Engineering and Design				$231,000
(b) Equipment				$743,000
(c) Installation				$798,000
(d) Facilities and Structure				$630,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$907,000
Total Capital Cost				$3,309,000
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements power	kWh	740000	$0.05	$37,000
Total Energy Requirements				$37,000
(b) Materials				
POLYMER				$193,000
NaOH	kg	220059	$0.485	$107,000
Total Materials				$300,000
(c) Operating Labour				
(d) Maintenance	% of Capital	5.00%		$165,000
Total Operating & Maintenance				$502,000
4. Disposal of Sludges or Solid Wastes				
(a) Quantities Generated per Unit Time		254	tonne/year	$51,000
(b) Disposal Cost per Unit		$200	$/tonne	
Comments:				

10.5 No. 1 Hot Mill

10.5.1 Existing

Currently 30% of the treated effluent from the No. 1 Hot Mill Filtration Plant is returned to No. 1 Hot Strip Mill, and 10,000 to 15,000 USGPM is discharged via the storm sewer and the Ottawa Street Slip to the bay. The filter plant has 14 gravity deep bed filter cells. The backwash from the filter is pumped to a holding tank which provides a relatively constant flow to a thickener. The thickener overflow is returned to filter cells numbers 9-14, while the sludge from the underflow is concentrated by a centrifuge. The scale pits at No. 1 Hot Strip Mill are much smaller than those at No. 2 Hot Strip Mill resulting in much higher loading of solids to the filter plant. In the present water system the piping arrangements and the lack of cooling capability limit the amount of water that can be returned to the mill.

10.5.2 BAT #1 Best in Ontario

In order to achieve a level of treatment equivalent to the Model BAT #1, the recycle rate must be increased from 30% to approximately 96%. Therefore a substantially higher flow with a higher solids loading will be recycled. In order to accommodate the increased recycle, the following new equipment is required: new piping and pumping facilities for the recirculation system, a cooling tower, a new thickener and a new filter cell. A small blowdown stream is discharged from this system. These modifications are shown in Figure 10.5.1 *Dofasco Inc. No. 1 Hot Mill Applied BAT #1 Best in Ontario.*

The predicted effluent quality data sheet, Table 10.5.1, for the modified treatment system is attached. The capital and operating data for this treatment system are given in Table 10.5.2.

10.5.3 BAT #2 Best in the United States

The BAT #2 treatment system is equivalent to the BAT #1 treatment with the blowdown reduced to 0.36 m^3/tonne.

The capital and operating cost data for this treatment system are given in Table 10.5.3.

10.5.4 BAT #3 Best at Selected World Locations

The best available Hot Forming technology was determined to be the BAT #2 treatment systems. The applied BAT #2 modifications are detailed in section 10.5.3.

10.5.5 BAT #4 Non-Lethal

The BAT #3 wastewater treatment technology for Hot Forming was determined to be the BAT #2 process. The applied BAT #2 modifications are outlined in section 10.5.3.

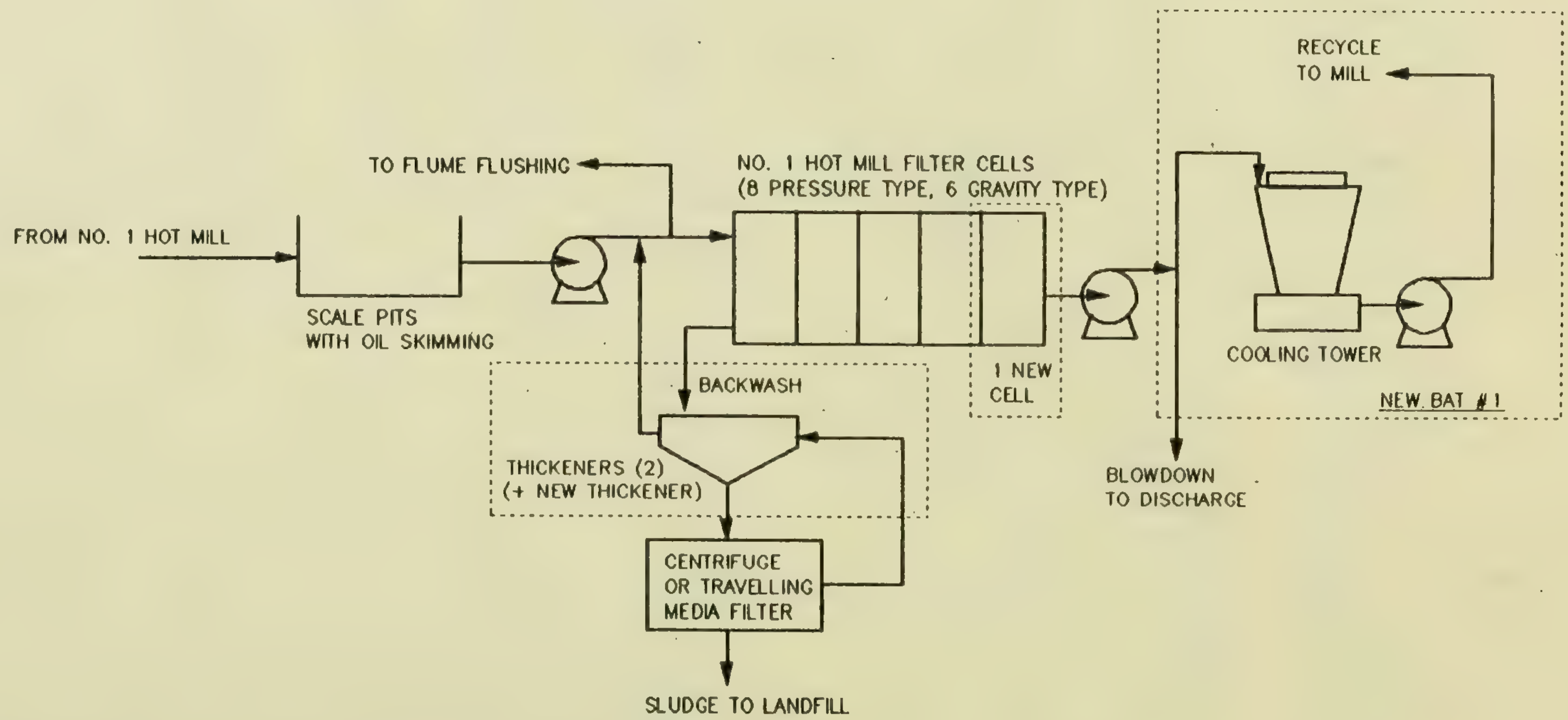
There is no specific toxicity data available for the BAT #3 Hot Forming wastewater stream. However, based on toxicity testing during the MISA monitoring period at Algoma (No. 2 Tube Mill), Dofasco (No. 2 Hot Mill), Stelco (No. 3 Bloom & Billet Mill) and USEPA toxicity testing of similar streams, the effluent is considered very likely to pass the Ontario Toxicity Test. This stream is discharged directly to the receiving water.

10.5.6 BAT #5 Virtual Elimination of Persistent Toxics

The BAT #3 wastewater treatment technology for Hot Forming was determined to be the BAT #2 process. The applied BAT #2 modifications are outlined in section 10.5.3.

Hot Forming wastewater streams do not normally contain toxic metals or organics. Virtual elimination of persistent toxics is therefore not a requirement in this case and BAT #5 is not applicable.

DOFASCO INC. - NO. 1 HOT MILL - APPLIED BAT #1 - BEST IN ONTARIO



PROCESS FLOW	BLOWDOWN FLOW	RECYCLE RATE
19.8 m3/tonne	0.85 m3/tonne	96 %

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FIGURE 10.5.1

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – HOT FORMING – DOFASCO

BAT	EXISTING		BAT #1 (Note 3)		BAT #2 (Note 3)		BAT #3	BAT #4	BAT #5
Flow (m3/day)	(Notes 1, 2)		8724		3695				
Parameter	Average Conc.	Average Loading	Average Conc.	Average Loading	Average Conc.	Average Loading			
	(mg/L)	(kg/day)	(mg/L)	(kg/day)	(mg/L)	(kg/day)			
TSS (Note 1)	31	2271	* 4.9	43	2.9	11	See BAT #2.	See BAT #2 (Note 4).	Not applicable.
TSS (Note 2)	* 4.8	24							
oil and grease (Note 1)	5.1	353	6.3	54	7.1	24			
oil and grease (Note 2)	-	-							

Notes:
1. No. 1 Hot Mill, MISA point 1100 (flow = 71118 m3/day).
2. No. 2 Hot Mill Filter Plant blowdown flow is approximately 4906 m3/day, including Cont. Cast. and Vac. Deg. blowdown flows (refer to Dofasco Mill Visit Report – Volume III). Concentration of TSS taken from Environment Canada Treatment Facilities Performance Evaluation Study. Loading TSS calculated from flow and concentration.
3. Calculations based on total production at the No. 1 and No. 2 Hot Mills.
4. The No. 2 HMFP blowdown was found to pass the Ontario Toxicity Test for Daphnia and Rainbow Trout (Iron and Steel Sector MISA Acute Lethality Study dated January 29, 1991).

* less than RMDL

1992-02-12	TABLE 10.5.1	HATCH ASSOCIATES	PEQHFDOF.WK1 PEQHFDOF.ALL	REV. # 4

TABLE 10.5.2 : MISA MODEL / APPLIED BAT COSTING				
Mill : Dofasco Inc. Subcategory : Hotforming BAT : 1, #1 Hot Mill Process Flow : 7994 m3/day (BLOWDOWN RATE) Date: January 30, 1992 Filename: DOFHM1CB.WK1				
1. Capital Costs				
(a) Engineering and Design				$1,426,000
(b) Equipment				$4,456,000
(c) Installation				$4,813,000
(d) Facilities and Structure				$4,144,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$5,604,000
Total Capital Cost				**$20,443,000**
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	**Commodity**	**Quantities per year**	**Unit Costs**	**Annual Costs**
(a) Energy Requirements power	kWh	9533252	$0.05	$477,000
Total Energy Requirements				**$477,000**
(b) Materials				
cooling tower chemicals				$200,000
Total Materials				**$200,000**
(c) Operating Labour	No increase			
(d) Maintenance	% of Capital	5.00%		$1,022,000
Total Operating & Maintenance				**$1,699,000**
4. Disposal of Sludges or Solid Wastes Increase over existing operation.				
(a) Quantities Generated per Unit Time		2340	tonne/year	$468,000
(b) Disposal Cost per Unit		200	$/tonne	
Comments: Net power increase assumed to be due only to cooling tower fans; additional power required for cooling tower pump assumed equal to reduced power required to operate bay water feed system and not included in total power.				

TABLE 10.5.3 : MISA MODEL / APPLIED BAT COSTING

Mill : Dofasco Inc.
Subcategory : Hotforming
BAT : 2, #1 Hot Mill
Process Flow : 2736 m3/day (BLOWDOWN RATE)
Date: January 30, 1992 Filename: DOFHM1CB.WK1

1. Capital Costs				
(a) Engineering and Design				$1,426,000
(b) Equipment				$4,456,000
(c) Installation				$4,813,000
(d) Facilities and Structure				$4,144,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$5,604,000
Total Capital Cost				$20,443,000
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements power	kWh	9533252	$0.05	$477,000
Total Energy Requirements				$477,000
(b) Materials				
cooling tower chemicals				$200,000
Total Materials				$200,000
(c) Operating Labour	No increase		$60,000	
(d) Maintenance	% of Capital	5.0%		$1,022,000
Total Operating & Maintenance				$1,699,000
4. Disposal of Sludges or Solid Wastes				
(a) Quantities Generated per Unit Time		2379	tonne/year	$476,000
(b) Disposal Cost per Unit		200	$/tonne	

Comments:
Net power increase assumed to be due only to cooling tower fans; additional power required for cooling tower pump assumed equal to reduced power required to operate bay water feed system and not included in total power.

10.6 Finishing

10.6.1 Existing

Finishing operations at Dofasco include Acid Pickling, Cold Rolling, Alkaline Cleaning, Annealing, Galvanizing, Electrolytic Tinning, Tempering and Coating. There are three finishing plants at the Dofasco facility. These include the Main Plant, the Kenilworth Plant and the Bayfront Finishing Operations.

The Main Plant finishing facilities are as follows :

- No. 1, 2 and 3 Pickle Lines
- No. 1 and 2 Cleaning Lines
- No. 1 and 2 Tandem Cold Mills
- 4-56 Inch Cold Mill
- 1-66 Inch Cold Mill
- 42 Inch Temper Mill
- 56 Inch Temper Mill
- 1-66 Inch Temper Mill
- 2-66 Inch Temper Mill
- Batch Annealing Lines
- Open Coil Annealing Lines
- No. 2 Tower Anneal Line
- No. 1 and 2 Galvanizing Lines
- No. 2 and 3 Electrolytic Plating Lines

The wastewater from the main plant finishing operations, including oily wastewater, alkaline and acid rinses, is treated at the Cold Mill Wastewater Treatment Plant (CMWWTP). The effluent from this facility is monitored at MISA MIDES # 1000 before discharge to the Hamilton-Wentworth sewage system. The Main Plant spent acid from the No. 1, 2 and 3 Pickle lines is regenerated at the No. 1 Acid Regeneration Plant (ARP). No. 1 ARP tail gas scrubber effluent is neutralized and discharged directly to the sanitary sewer.

The Kenilworth Plant finishing operations include the No. 4 Pickle Line and the new Continuous Pickle Continuous Cold Mill Line which is under construction. The acid rinse from the No. 4 Pickle line is currently discharged to the sanitary sewer system. Spent acid from the No. 4 Pickle line is currently regenerated at the No. 2 ARP. Wastewater from the No. 2 ARP tail gas scrubbers is currently discharged to the Hamilton-Wentworth sanitary sewer system after neutralization. Dofasco plans to discharge acid from the No. 4 Pickle line, tail gas scrubber effluent from the No. 2 ARP and acid rinses from the new Continuous Pickle Cold Mill Line to the Kenilworth Cold Mill Wastewater Treatment Plant, once construction of this facility is completed. [1]

Finishing facilities are also located at the Bayfront Finishing Operations. This plant has the following finishing facilities:

- No. 3 Galvanizing Line
- No. 4 Galvanizing Line
- No. 5-56 Inch Cold Mill
- Magnesium Oxide Coating Line

The rinsewater and sump water from the No. 3 and No. 4 Galvanizing Lines is discharged directly to the sanitary sewer system. Spent high density cleaning solution from the No. 4 Galvanizing Line and the wastewater from the recoiler and payoff pits at the No. 3 and No. 4 Galvanizing Lines is collected and transported to the Main Plant Cold Mill Wastewater Treatment Plant. Waste rolling solution and washdown water from the No.5-56 Inch Cold Mill is also treated at the Main Plant Cold Mill Wastewater Treatment Plant. The wastewater from the Magnesium Oxide Coating Line is directed to the Magnesium Oxide Clarifier then discharged to the sanitary sewer system.

[1] As of January 1, 1992 these plans have been implemented.

10.6.2 BAT #1 Best in Ontario

Dofasco's Cold Mill Wastewater Treatment Plant was determined to be the best available treatment system in Ontario since it was the only mill for which MISA effluent data was available. However, the performance of this facility should not be considered as satisfactory. The current effluent does not meet the sanitary sewer bylaw for TSS due to lack of equalization and poor operation of the clarifiers. No modifications to the wastewater treatment system are required for applied BAT #1.

No modifications to the Bayfront Finishing Operations are required for applied BAT #1.

10.6.3 BAT #2 Best in the United States

In order to achieve a BAT #2 level of effluent quality at the CMWWTP, equalization of the wastewater streams prior to treatment is required. This will improve the operation of the reaction tanks and clarifiers by providing a uniform flowrate through the system. Baffles should be added to the two neutralization tanks. In addition, upgrades to the clarifiers and new sand filters are required to improve solids removal. A dissolved air flotation system is also required to further treat the de-emulsified oily wastewater. These modifications are shown in Figure 10.6.1 *Dofasco Inc. Finishing Applied BAT #2 Best in the United States*.

The effluent from the scrubbers at the #1 Acid Regeneration Plant should also be treated to achieve the BAT #2 effluent quality. Treatment of the effluent in a wastewater treatment facility consisting of pH adjustment, solids removal and filtration is required.

In order to upgrade the Bayfront Finishing operations wastewater treatment to the BAT #2 level of treatment, metals removal and sand filtration for improved solids removal are required.

The predicted effluent quality data sheet, Table 10.6.1, for the modified treatment system is attached. The capital and operating cost data for this treatment system are given in Tables 10.6.2 and 10.6.3.

10.6.4 BAT #3 Best at Selected World Locations

The best available Finishing technology was determined to be the BAT #2 treatment systems. The applied BAT #2 modifications are detailed in section 10.6.3.

10.6.5 BAT #4 Non-Lethal

The BAT #3 wastewater treatment technology for Finishing was determined to be the BAT #2 process. The applied BAT #2 modifications are outlined in section 10.6.3.

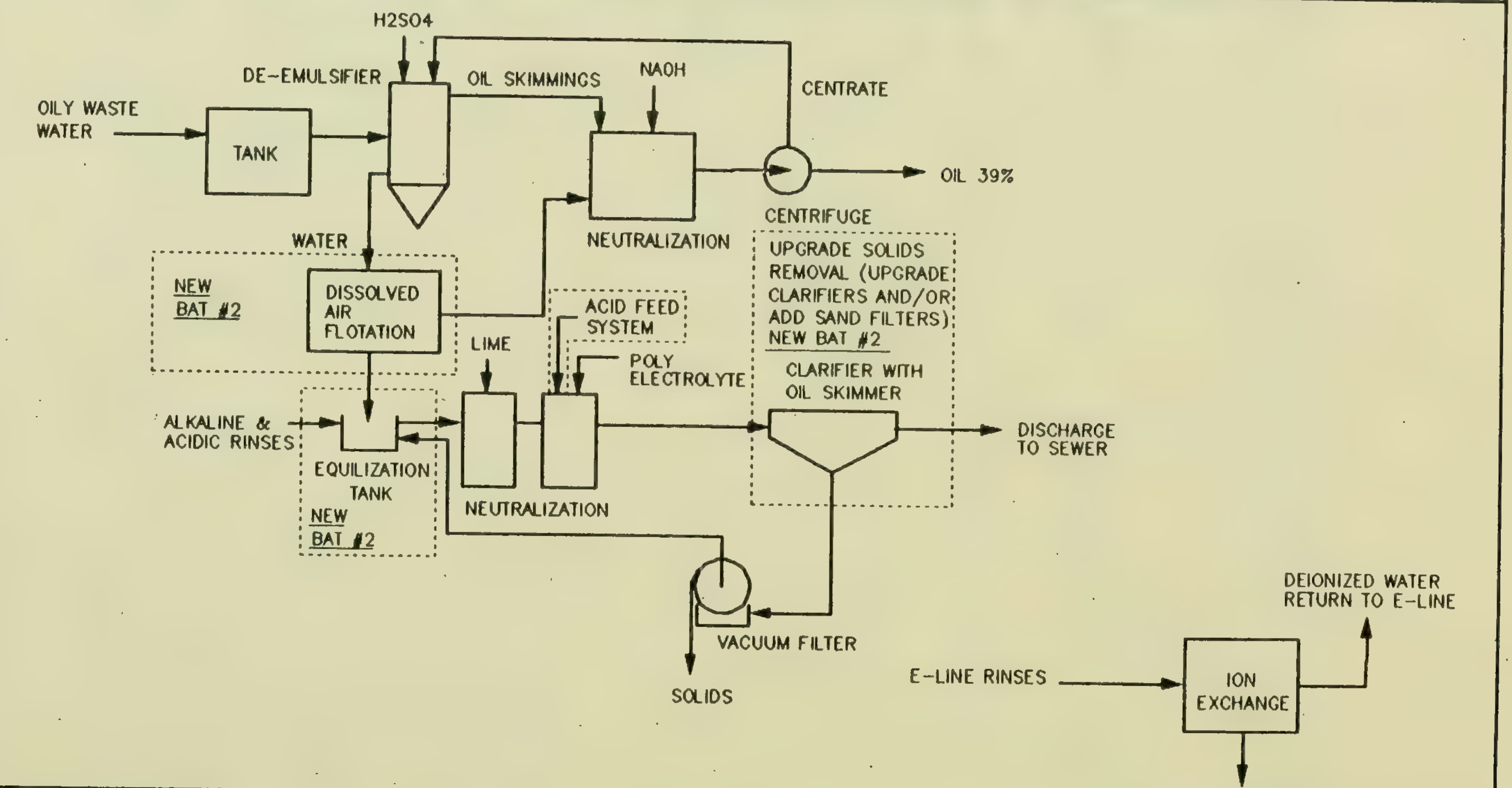
There is no specific toxicity data available for the BAT #3 Finishing wastewater stream. However, the zinc, chromium and hexavalent chromium were determined to be below the single contaminant LC50 values. Therefore, the effluent may pass the Ontario Toxicity Test, depending on synergistic effects and hardness. The synergistic effects of the several contaminants in the effluent are not known and cannot be predicted. No demonstrated technologies are known to further reduce the concentrations of metal toxics to lower levels than those measured in this wastewater. This stream is not combined with other streams prior to discharged to Hamilton Harbour.

10.6.6 BAT #5 Virtual Elimination of Persistent Toxics

The BAT #3 wastewater treatment technology for Finishing was determined to be the BAT #2 process. The applied BAT #2 modifications are outlined in section 10.6.3.

The Finishing wastewater stream is expected to contain low levels of metal toxic contaminants. No demonstrated technologies are known of further reduce the concentrations of these compounds to lower levels those than measured in the wastewater stream. Virtual elimination of persistent toxics can only be assured by zero discharge. This may be achieved with further treatment by ultrafiltration and ion exchange, or evaporation which may permit the treated water to be recycled to the process. However, these treatment technologies are not demonstrated in this industrial sector.

DOFASCO INC. - FINISHING - APPLIED BAT #2 - BEST IN THE UNITED STATES



FLOWRATE 1.1 m3/pickled tonne	NO RECYCLE	

DOFASCO INC.	HATCH ASSOCIATES	1991-10-07	REV. 2

FIGURE 10.6.1

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – FINISHING – DOFASCO (Note 4)

BAT	EXISTING (Note 1)		BAT #1 (Note 2)	BAT #2 (Note 3)		BAT #3	BAT #4	BAT #5
Flow (m3/day)	4875		13820	37480				
Parameter	Average Conc. (mg/L)	Average Loading (kg/day)		Average Conc. (mg/L)	Average Loading (kg/day)			
TSS	487	2298	See existing plus Bayfront Plant plus Kenilworth Plant existing.	4.8	178	See BAT #2.	See BAT #2.	No demonstrated technology in this industry sector.
oil and grease	68	326		2.3	86			
lead	0.088	0.41		-	-			
zinc	0.15	0.74		0.054	2.0			
chromium	0.80	3.8		0.051	1.9			
hexavalent chromium	-	-		0.010	0.41			

Notes:
1. Data direct from MISA MIDES #1000 (Cold Mill WWTP Sewer); no other finishing data available. Includes wastewater from the Main Plant (excluding the No.1 ARP) and the Bayfront Plant (including the #556 Cold Mill, the #3 and #4 Galvanizing Lines recoiler and payoff pits wastewater and the #4 Galvanizing Line waste cleaner solution).
2. Includes flow from the Main Plant Cold Mill WWTP (4875 m3/day), flow from the Bayfront Plant (1505 m3/day; includes the #3 and #4 Galvanizing Lines rinse and sump water and the MgO Coating Line wastewater), flow from the No. 1 ARP (6450 m3/day), and the current flow from the Kenilworth Plant (900 m3/day; includes No. 4 Pickle line rinse water and No. 2 ARP tail gas scrubber effluent).
3. Applied flow and loadings are shown for Model BAT #2 values times Dofasco production for the AP Lines No. 1,2,3 and 4. The Model BAT #2 concentrations are shown.
4. The production from the new Kenilworth Cold Mill Acid Pickling and associated flows from the new Kenilworth WWTP are excluded from this table.

1992-03-13	TABLE 10.6.1	HATCH ASSOCIATES	PEQFNDOF.WK1 PEQFNDOF.ALL	REV. # 4

TABLE 10.6.2 : MISA MODEL / APPLIED BAT COSTING				
Mill : Dofasco Inc. Subcategory : Finishing BAT : 2, Cold Mill Waste Water Treatment Plant Process Flow : 7904 m3/day (BLOWDOWN RATE) Date: September 9, 1991			Filename:	DOFFICB.WK1
1. Capital Costs				
(a) Engineering and Design				$1,272,000
(b) Equipment				$4,099,000
(c) Installation				$4,398,000
(d) Facilities and Structure				$3,466,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$4,998,000
Total Capital Cost				$18,233,000
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements Power	kWh	1339667	$0.05	$67,000
Total Energy Requirements				$67,000
(b) Materials				
NaOH	kg	209317	$0.122	$26,000
Total Materials				$26,000
(c) Operating Labour	No increase		$60,000	
(d) Maintenance	% of Capital	5.00%		$912,000
Total Operating & Maintenance				$1,005,000
4. Disposal of Sludges or Solid Wastes				
(a) Quantities Generated per Unit Time		2400	tonne/year	$480,000
(b) Disposal Cost per Unit		200	$/tonne	
Comments:				

TABLE 10.6.3 : MISA MODEL / APPLIED BAT COSTING				
Mill :	Dofasco Inc.			
Subcategory :	Finishing, #3 & #4 Galvanizing Line, Special Steels			
BAT :	2 Bayfront Cold Mill Waste Water Treatment Plant			
Process Flow :	2452 m3/day (BLOWDOWN RATE)			
Date:	92/03/10		Filename:	DOFBFFI.WK1
1. Capital Costs				
(a) Engineering and Design				$581,000
(b) Equipment				$1,984,000
(c) Installation				$2,103,000
(d) Facilities and Structure				$1,379,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$2,283,000
Total Capital Cost				**$8,330,000**
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	**Commodity**	**Quantities per year**	**Unit Costs**	**Annual Costs**
(a) Energy Requirements power	kWh	810636	$0.05	$41,000
Total Energy Requirements				**$41,000**
(b) Materials				
	H2SO4	32800	$0.122	$4,000
	NaOH	243000	$0.485	$118,000
Total Materials				**$122,000**
(c) Operating Labour	No increase		$60,000	
(d) Maintenance	% of Capital	5.00%		$417,000
Total Operating & Maintenance				**$580,000**
4. Disposal of Sludges or Solid Wastes				
(a) Quantities Generated per Unit Time		200	tonne/year	$40,000
(b) Disposal Cost per Unit		200	$/tonne	
Comments:				

10.7 Integrated Mills Including Finishing

10.7.1 BAT #1 Best in Ontario

BAT #1 is based on data for Stelco LEW's final effluent and data for Dofasco's Finishing effluent.

In order to upgrade the wastewater treatment facilities at Dofasco to the BAT #1 treatment system, biological treatment facilities are required to treat the Cokemaking wastewater. In addition, a cooling tower is required for the Steelmaking wastewater system to recycle the water to the process. A Blowdown Treatment Plant is required to treat the effluent from the Cokemaking, Ironmaking and Steelmaking systems prior to discharge. The Cokemaking and Ironmaking wastewater is combined for metals removal and chlorination; then combined with the Steelmaking wastewater for filtration prior to discharge. A separate metals removal step is required for the steelmaking wastewater.

A thickener and a vacuum filter are required for solids handling at the No. 2 Hot Mill and Continuous Caster wastewater treatment system. At the No. 1 Hot Mill a cooling tower is required to recycle the water to the process. In addition, a new thickener and filter cell are required at the Filter Plant for improved solids removal. Upgrades to the Bayfront Finishing Operations and the Cold Mill Wastewater Treatment Plant are also required.

These modifications are shown in Figure 10.7.1 *Dofasco Inc. Integrated Mills Including Finishing Applied BAT #1 Best in Ontario*. A summary of the Applied BAT #1 Capital Costs is given in Table 10.7.2.

The predicted effluent data for these modifications is given in Table 10.7.1. As discussed in Section 7.1, this table is presented for information purposes only.

10.7.2 BAT #2 Best in The United States

The predicted effluent data for BAT's 2A, 2B and 3 is given in Table 10.7.1. BAT #2A is based on National Steel, Granite City which is an integrated mill with central treatment facilities and finishing operations. BAT #2B is based on the sum of the BAT #2 for all categories, including National Steel, Midwest for the Finishing component of an integrated mill.

A summary of the Applied BAT #2 Capital Costs is given in Table 10.7.3.

10.7.3 BAT #3 Best at Selected World Locations

The best available integrated wastewater treatment facility was determined to be the BAT #1 facility. The applied BAT #1 modification are described in section 10.7.1.

The predicted effluent data for BAT #3 , given in Table 10.7.1, is based on data for Stelco LEW's final effluent, and data for National Steel Midwest for finishing effluent.

10.7.4 BAT #4 Non-Lethal

The BAT #3 wastewater treatment technology for Bat #4 Integrated Mills including Finishing was determined to be the BAT #1 process. The applied BAT #1 modifications are outlined in section 10.7.1.

The treated wastewater streams from the various process areas are not combined in a centralized treatment plant prior to discharge, as at Stelco LEW. Therefore, the Stelco LEW toxicity data cannot be used to assess the toxicity of the discharges from Dofasco. Assessments of the toxicity of the wastewater streams discharged from this facility are described in the previous sections.

10.7.5 BAT #5 Virtual Elimination of Persistent Toxics

The BAT #3 wastewater treatment technology for Integrated Mill including Finishing was determined to be the BAT #1 process. The applied BAT #1 modifications are outlined in section 10.7.1.

Assessments of each of the effluent streams for persistent toxic contaminants are described in the previous sections.

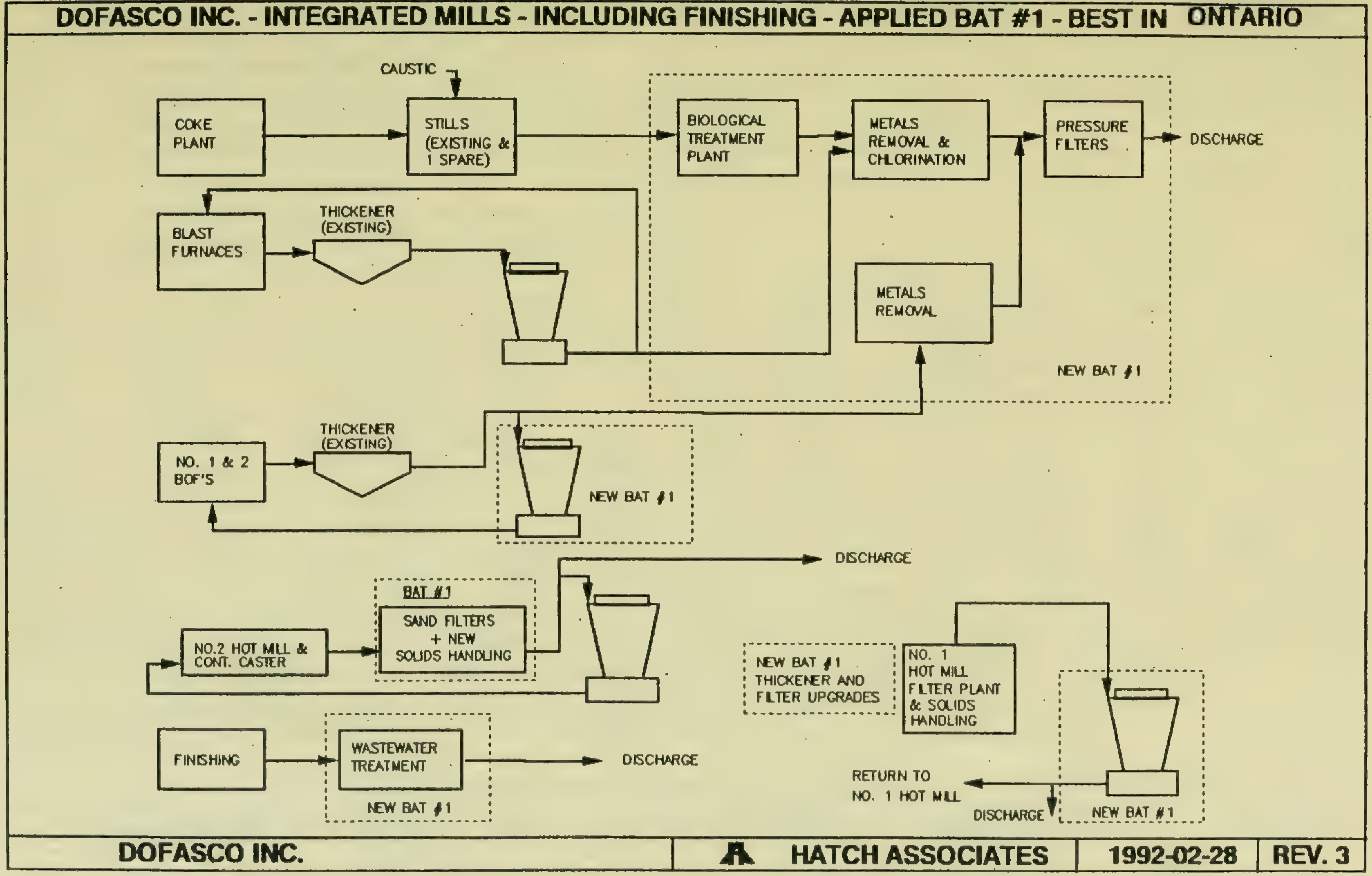

DOFASCO INC. - INTEGRATED MILLS - INCLUDING FINISHING - APPLIED BAT #1 - BEST IN ONTARIO
CAUSTIC
COKE PLANT
STILLS (EXISTING & 1 SPARE)
BIOLOGICAL TREATMENT PLANT
METALS REMOVAL & CHLORINATION
PRESSURE FILTERS
DISCHARGE
BLAST FURNACES
THICKENER (EXISTING)
METALS REMOVAL
NEW BAT #1
NO. 1 & 2 BOF'S
THICKENER (EXISTING)
NEW BAT #1
DISCHARGE
BAT #1
SAND FILTERS + NEW SOLIDS HANDLING
NO.2 HOT MILL & CONT. CASTER
NEW BAT #1 THICKENER AND FILTER UPGRADES
NO. 1 HOT MILL FILTER PLANT & SOLIDS HANDLING
FINISHING
WASTEWATER TREATMENT
NEW BAT #1
DISCHARGE
RETURN TO NO. 1 HOT MILL
DISCHARGE
NEW BAT #1
DOFASCO INC.
HATCH ASSOCIATES
1992-02-28
REV. 3

FIGURE 10.7.1

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – INCLUDING FINISHING – DOFASCO

(Note 1)

BAT	EXISTING (Note 2)		BAT #1 (Note 3)		BAT #2A (Note 4)		BAT #2B (Note 3)		BAT #3 (Note 3)		BAT #4	BAT #5
Flow (m3/day)	562341		51935		100357		35570		73605			
Parameter	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)		
TSS	34	18856	49	2528	5.4	542	8.3	296	4.8	357		
oil and grease	1.9	1089	7.5	390	4.9	492	2.5	88	1.7	126	See	Note 5
ammonia + ammonium	1.2	667	* 0.075	3.9	0.59	59	4.5	161	0.053	3.9	BAT #3.	
cyanide total	0.18	103	0.10	5.3	0.0034	0.34	0.42	15	0.072	5.3		
phenolics (4AAP)	0.055	31	0.0021	0.11	0.0029	0.29	0.0085	0.30	0.0015	0.11		
lead	* 0.029	16	0.037	1.9	0.0047	0.47	0.0039	0.14	0.020	1.5		
zinc	0.05	26	0.072	3.7	0.045	4.5	0.057	2.0	0.060	4.4		
benzene	* 0.00019	0.11	* 0.00023	0.012	-	-	0.00017	0.0060	0.00016	0.012		
benzo(a)pyrene	* 0.00052	0.30	* 0.00046	0.024	-	-	0.0012	0.044	0.00033	0.024		
naphthalene	* 0.00030	0.17	* 0.00027	0.014	-	-	0.00065	0.023	0.00019	0.014		
chromium	0.029	17	0.082	4.3	-	-	0.038	1.3	0.024	1.8		
hexavalent chromium	0.010	5.8	-	-	-	-	0.0080	0.29	0.0039	0.29		

Notes:
1. Based on production at Dofasco's No. 1, 2 and 3 Acid Pickle Lines.
2. Sum of all wastewater discharges from Dofasco (MISA Monitoring Points 0100, 0200, 0400, 1000); Includes NCCW and stormwater.
3. Loading (kg/day) = Loading Excluding Finishing (g/tonne) times Steelmaking Production (tonne/day) + Loading Finishing (g/tonne) x Acid Pickling production (tonne/day).
4. Calculations based on Dofasco's Steelmaking production only (Dofasco's acid pickling prod'n approx 20% > National, Granite BAT #2-A).
5. No demonstrated technology in this industry sector.

* less than RMDL

1992-02-13	TABLE 10.7.1	HATCH ASSOCIATES	PEQCTDOF.WK1 PEQCTDOF.ALL	REV. # 3

TABLE 10.7.2 : DOFASCO STEEL

BAT #1 COSTING SUMMARY

FACILITY	EST CAP COST $MM		EST TYPE
Cokemaking			
Blow down treatment plant	3.0		A
Bio plant	27.3		A
3rd ammonia still (also BAT #2)	2.0		C
gravel filters	1.5		C
#1 PEC blow down reroute (& #2)	0.3	Total=34.1	D
Ironmaking			
Blow down treatment plant	8.6		A
Interconnecting services (also BAT #2)	0.4		D
Pretreatment/Equalization tank (& #2)	3.1		C
Upstream changes (& #2)	0.7		D
Separation of thickener underflows (& #2)	3.0		C
Slag pit recycle (baywater)	2.3		C
Degritting of floc tank residue (& #2)	0.1	Total=18.2	C
Steelmaking			
Blow down treatment plant	13.5		A
#1 meltshop recirc. system (& #2)	26.1		B
#2 meltshop recirc system (& #2)	7.8		A
Interconnecting services (& #2)	0.4	Total=47.8	D
Hot forming - #1 hot mill			
#1 hot mill Recycle system	14.9		B
Thickener	1.7		C
Filter upgrade	3.8	Total=20.4	C
Hot forming - #2 hot mill & caster (BDTP not costed)			
Thickener	2.3		C
Beltpress filter	0.8		C
Decant/Settler reroute piping	0.2	Total=3.3	C
Finishing (main plant)			
already exists	0.0		N/A
TOTAL WORKS	123.8		

TABLE 10.7.3 : DOFASCO STEEL

BAT #2COSTING SUMMARY

FACILITY	EST CAP COST $MM		EST TYPE
Cokemaking			
Bio plant	28.3		A
Items from BAT #1	2.3	Total=30.6	C
Ironmaking			
Blow down treatment plant	3.5		A
Slag pit recycle (baywater)	2.3		C
Items from BAT #1	7.3	Total=13.1	C
Steelmaking			
Items from BAT #1	34.3		A
Blowdown treatment for shop #1	4.1		A
Reroute intermittent blow down			
Holding tank	0.5		C
Sand filter	0.5		C
Pumps & piping	0.1		C
CO2 addition system	0.1	Total=39.6	C
Hot forming - #1 hot mill			
#1 hot mill Recycle system	14.9		B
Thickener	1.7		C
Filter upgrade	3.8	Total=20.4	C
Hot forming - #2 hot mill & caster (BDTP not costed)			
Thickener	2.3		C
Beltpress filter	0.8		C
Decant/Settler reroute piping	0.2	Total=3.3	C
Finishing (main plant)			
Pressurization system	0.5		C
Clarifier & flotation conveyor	1.0		C
Misc. equipment allowance	0.9		C
Special structures over road	0.9		C
Sand filters	1.1		C
Additional pumps	0.2		C
Recirculation piping & pumps	1.0		C
Clarifier upgrade (internals)	0.3		D
Equalization tank	4.5		C
Pretreatment tank	0.6		D
Acid addition systems (2)	0.3		C
ARP system	6.7		B
ARP interconnecting services	0.1	Total=18.1	C
Bayfront Finishing			
metals precip. & sand filtr.	8.3	Total=8.3	A
TOTAL WORKS	**133.4**		

11.0 APPLIED BAT IVACO ROLLING MILLS

11.1 BAT #1 Best in Ontario

Ivaco Rolling Mills in L'Orignal, Ontario was determined to have the best available wastewater treatment facility in Ontario. There was no wastewater discharged from the facility during the MISA monitoring period. Ivaco have indicated, however, that this system has been operating in an experimental mode and they cannot maintain zero discharge. They intend to discharge an average of 0.26 m^3/tonne to 1.0 m^3/tonne.

This wastewater will be filtered prior to discharge. Filters are presently being installed for this purpose. After review at the BAT Subcommittee of the Joint Technical Committee, it was resolved that this would be selected as BAT #1. The BAT #1 treatment system is shown in Figure 11.6.1 *Ivaco Rolling Mills Applied BAT #1 Best in Ontario*.

The predicted effluent quality data sheet, Table 11.1, for the modified treatment systems is attached. The capital and operating cost data for the new filtration system are given in Table 11.2.

11.2 BAT #2 Best in the United States

In order to upgrade the system to the Model BAT #2 treatment, a cold lime softening process is required to treat the backwash from the filter and a small blowdown from the system. The softened water is returned to the process and the sludge is dewatered and landfilled. This system operates with a recycle of 98%, with the blowdown evaporated on slag or used for electrode cooling. Since there are no organic contaminants present in this wastewater stream, concerns regarding leaching of contaminants from slag used in road construction were assumed to be not applicable. There may be very low levels of zinc present in the blowdown stream. There are concerns, however, regarding the transferability of the Cold Lime Softening technology. The application of this Technology depends on the specific water chemistry and the specific operation at the mill in question. For example high total dissolved solids in fresh water could

lead to harmful deposits on rolls, etc. There is no wastewater discharged from this system. This treatment system is shown in Figure 11.2 *Ivaco Rolling Mills Applied BAT #2 Best in the United States*.

The capital and operating data for this treatment system are given in Table 11.3.

11.3 BAT #3 Best at Selected World Locations

The best available wastewater treatment technology was determined to be the BAT #2 treatment system. The applied BAT #2 modifications are detailed in section 11.2.

11.4 BAT #4 Non-Lethal

The BAT #3 wastewater treatment technology for Mini Mills was determined to be the BAT #2 process. The applied BAT #2 modifications are outlined in section 11.2. There is no discharge with this technology. Therefore, there is no discharge of a lethal effluent.

BAT #1 is also expected to be non-lethal depending on the dissolved solids concentration in the effluent.

11.5 BAT #5 Virtual Elimination of Persistent Toxics

The BAT #3 wastewater treatment technology for Mini Mills was determined to be the BAT #2 process. The applied BAT #2 modifications are outlined in section 11.2. BAT #2 has achieved virtual elimination by using the effluent for slag cooling and electrode cooling.

BAT #1 may also achieve virtual elimination depending on the concentrations of lead and zinc in the effluent.

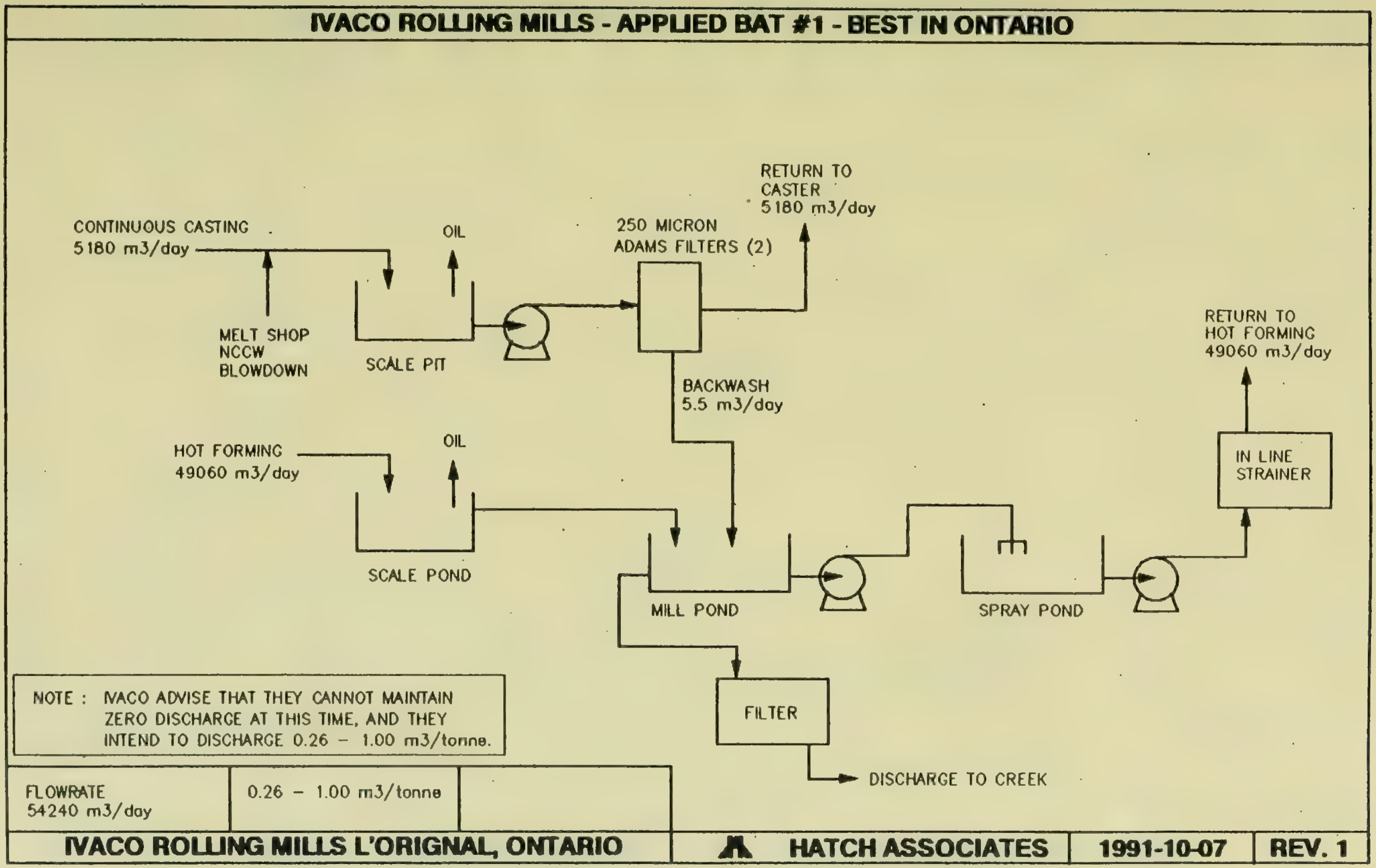
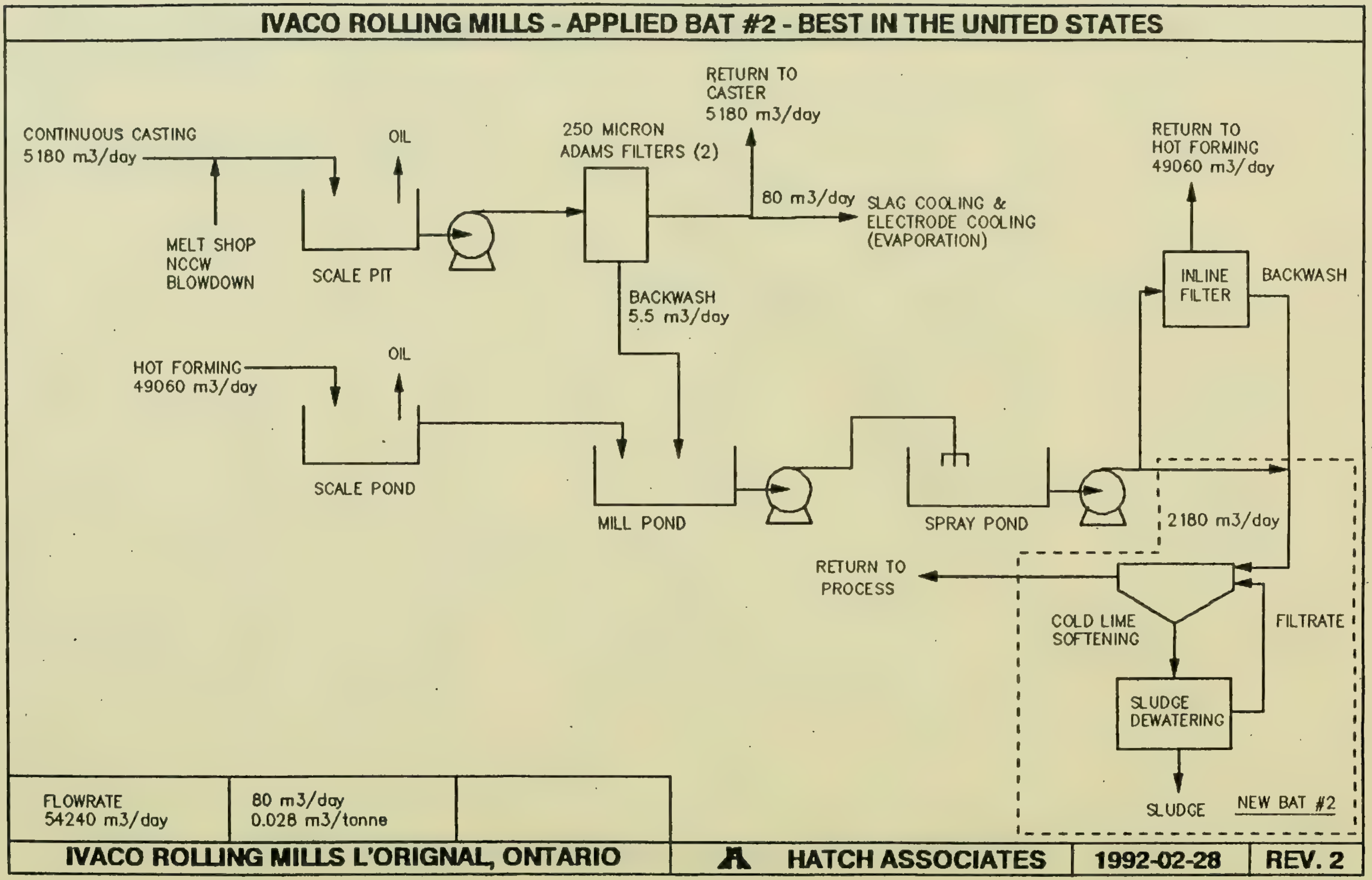

IVACO ROLLING MILLS - APPLIED BAT #1 - BEST IN ONTARIO
CONTINUOUS CASTING
5180 m3/day
MELT SHOP
NCCW
BLOWDOWN
OIL
SCALE PIT
250 MICRON
ADAMS FILTERS (2)
RETURN TO
CASTER
5180 m3/day
BACKWASH
5.5 m3/day
HOT FORMING
49060 m3/day
OIL
SCALE POND
MILL POND
SPRAY POND
RETURN TO
HOT FORMING
49060 m3/day
IN LINE
STRAINER
FILTER
DISCHARGE TO CREEK
NOTE : IVACO ADVISE THAT THEY CANNOT MAINTAIN ZERO DISCHARGE AT THIS TIME, AND THEY INTEND TO DISCHARGE 0.26 – 1.00 m3/tonne.
FLOWRATE
54240 m3/day
0.26 – 1.00 m3/tonne
IVACO ROLLING MILLS L'ORIGNAL, ONTARIO
HATCH ASSOCIATES
1991-10-07
REV. 1

FIGURE 11.1



IVACO ROLLING MILLS - APPLIED BAT #2 - BEST IN THE UNITED STATES
CONTINUOUS CASTING
5180 m3/day
MELT SHOP
NCCW
BLOWDOWN
OIL
SCALE PIT
250 MICRON
ADAMS FILTERS (2)
RETURN TO
CASTER
5180 m3/day
80 m3/day
SLAG COOLING &
ELECTRODE COOLING
(EVAPORATION)
BACKWASH
5.5 m3/day
HOT FORMING
49060 m3/day
OIL
SCALE POND
MILL POND
SPRAY POND
RETURN TO
HOT FORMING
49060 m3/day
INLINE
FILTER
BACKWASH
2180 m3/day
RETURN TO
PROCESS
COLD LIME
SOFTENING
FILTRATE
SLUDGE
DEWATERING
SLUDGE
NEW BAT #2
FLOWRATE
54240 m3/day
80 m3/day
0.028 m3/tonne
IVACO ROLLING MILLS L'ORIGNAL, ONTARIO
HATCH ASSOCIATES
1992-02-28
REV. 2

FIGURE 11.2

TABLE 11.2 : MISA MODEL / APPLIED BAT COSTING				
Mill : IVACO Subcategory : MINI MILLS BAT : 1 Process Flow : 54240 M3/DAY Blowdown Filtration System 1091 m3/d Date: 92/03/10 Filename: IVAC-CB1.WK1				
1. Capital Costs				
(a) Engineering and Design				$14,000
(b) Equipment				$45,000
(c) Installation				$50,000
(d) Facilities and Structure				$43,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$56,000
Total Capital Cost				$208,000
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements		600000	$0.05	$30,000
Total Energy Requirements				$30,000
(b) Materials				
Total Materials				$0
(c) Operating Labour	MEN	0.5	$60,000	$30,000
(d) Maintenance	% OF CAPITAL	5.00%		$10,000
TOTAL OPERATING & MAINTENANCE				$70,000
4. Disposal of Sludges or Solid Wastes				
(a) Quantities Generated per Unit Time		19	tonne/yr	$3,800
(b) Disposal Cost per Unit		200	$/tonne	
Comments:				

PREDICTED EFFLUENT QUALITY

MINI MILLS – IVACO

BAT	EXISTING		BAT #1		BAT #2		BAT #3	BAT #4	BAT #5
Flow (m3/day)			991						
Parameter	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)			
TSS	Note 1		10	9.9	No discharge to receiving water (Note 2).		See BAT #2.	See BAT #2.	See BAT #2.
oil and grease			5.0	5.0					
lead			–	–					
zinc			–	–					

Notes 1. During the MISA Monitoring Period, Ivaco, operating in experimental mode, did not discharge any effluent. Ivaco advise that they cannot maintain this mode of operation and they intend to discharge the flow and pollutant loadings presented in BAT #1. They intend to discharge an average of 0.26 m3/tonne to a maximum of 1.0 m3/tonne. Average expected blowdown concentrations were estimated by Ivaco to be < 10 mg/L TSS and < 5 mg/L oil and grease. Average Loading was calculated from Average Concentration and Flow.

2. Nucor, Crawfordsville achieves no discharge to receiving water partly by evaporating blowdown on slag and partly by evaporation in electrode cooling.

1991-10-07	TABLE 11.1	HATCH ASSOCIATES	PEQMMIVA.WK1 PEQMMIVA.ALL	REV. # 0

TABLE 11.3 : MISA MODEL / APPLIED BAT COSTING				
Mill : IVACO				
Subcategory : MINI MILLS				
BAT : 2				
Process Flow : 54240 M3/DAY Cold lime softening				
Date: 92/03/10			Filename:	IVAC-CB2.WK1
1. Capital Costs				
(a) Engineering and Design				$155,000
(b) Equipment				$483,000
(c) Installation				$521,000
(d) Facilities and Structure				$449,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$608,000
Total Capital Cost				$2,216,000
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements	kWh	87600	$0.05	$4,000
Total Energy Requirements				$4,000
(b) Materials				
Soda ash	Tonnes	404	$265.00	$107,000
Calcium Carbonate	Tonnes	135	$90.00	$12,000
Total Materials				$119,000
(c) Operating Labour	Manyears	0.5	$60,000	$30,000
(d) Maintenance	% of Capital	5.00%		$110,800
TOTAL OPERATING & MAINTENANCE				$264,000
4. Disposal of Sludges or Solid Wastes				
(a) Quantities Generated per Unit Time		1997	tonne/year	$399,000
(b) Disposal Cost per Unit		$200		
Comments:				

12.3 BAT #3 Best at Selected World Locations

The best available wastewater treatment technology was determined to be the BAT #2 treatment system. The applied BAT #2 modifications are detailed in section 12.2.

12.4 BAT #4 Non-Lethal

The BAT #3 wastewater treatment technology for Mini Mills was determined to be the BAT #2 process. The applied BAT #2 modifications are outlined in section 12.2. There is no discharge with this technology. Therefore, there is no lethal effluent from the process.

BAT #1 is also expected tc :e non-lethal depending on the dissolved solids concentration on the effluent.

12.5 BAT #5 Virtual Elimination of Persistent Toxics

The BAT #3 wastewater treatment technology for Mini Mills was determined to be the BAT #2 process. The applied BAT #2 modifications are outlined in section 12.2. BAT #2 has achieved virtual elimination by using the effluent for slag cooling and electrode cooling.

BAT #1 may also achieve virtual elimination depending on the concentrations of lead and zinc in the effluent.

12.0 APPLIED BAT LAKE ONTARIO STEEL

12.1 BAT #1 Best in Ontario

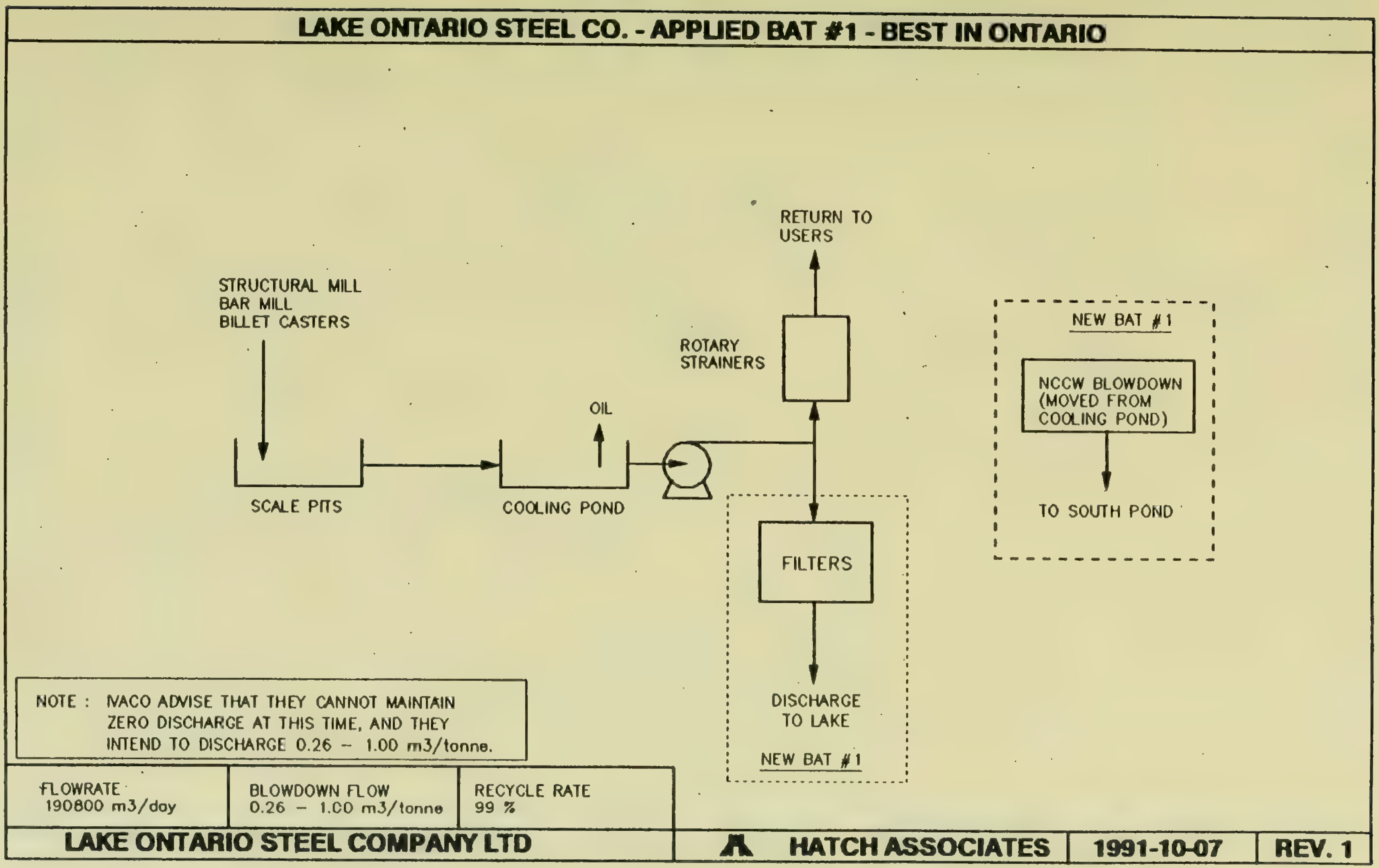
In order to achieve the BAT #1 level of treatment, the non-contact cooling water blowdown must be rerouted from the cooling pond to the south pond to separate it from the process water. The process water should be recycled with a small blowdown of 0.26-1.0 m^3/tonne. The blowdown stream should be filtered prior to discharge. This treatment system is shown in Figure 12.1 *Lake Ontario Steel Co. Applied BAT #1 Best in Ontario.* The NCCW blowdown can be used as make-up to the process water system.

The predicted effluent quality data sheet, Table 12.1, for the modified treatment system, is attached. The capital and operating cost data for this treatment system are given in Table 12.2.

12.2 BAT #2 Best in the United States

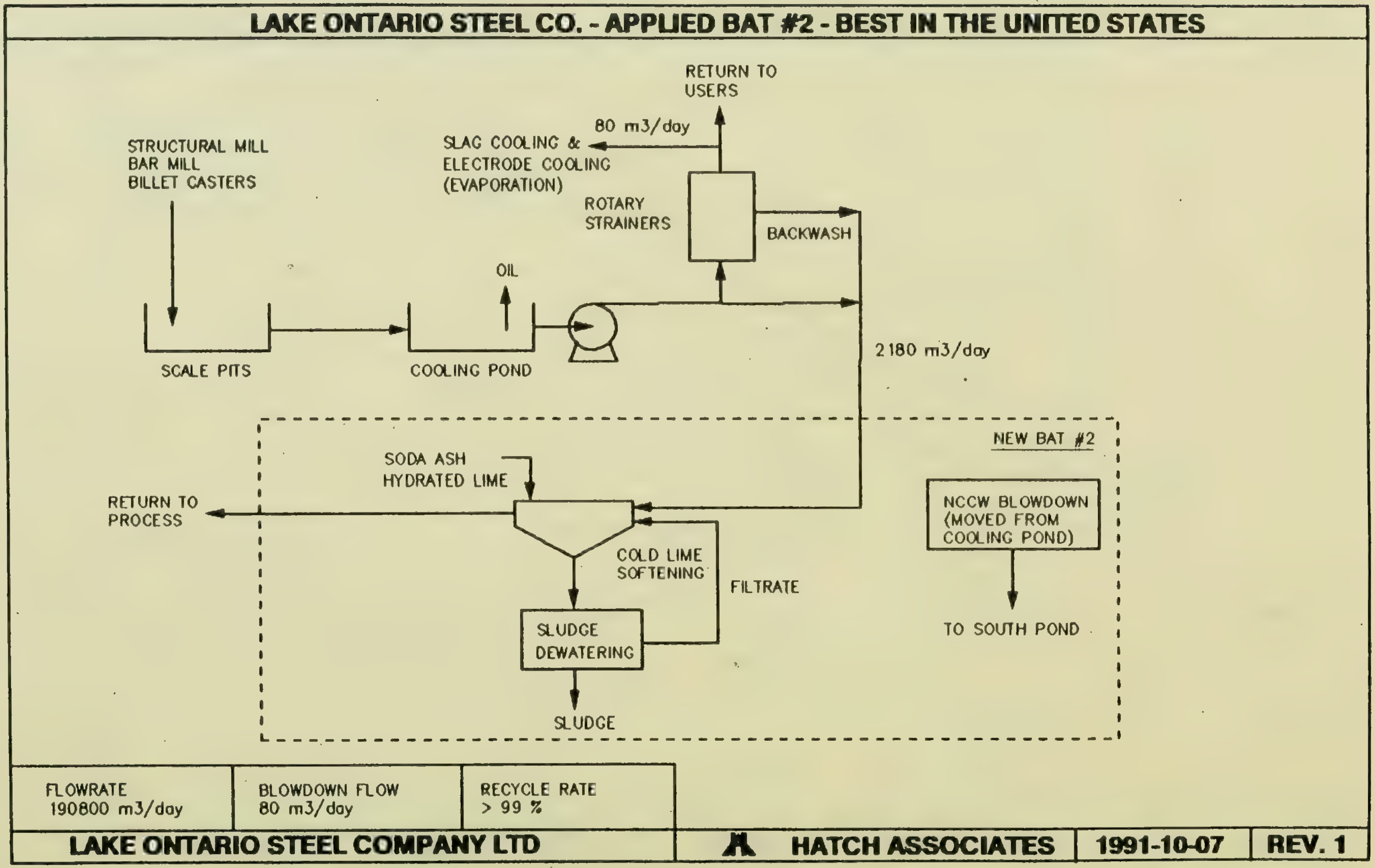
In order to upgrade the system to the Model BAT #2 treatment, a cold lime softening process is required to treat the backwash from the strainers and a small blowdown from the system. The softened water is returned to the process and the sludge is dewatered and landfilled. There is no wastewater discharged from this system. The blowdown stream from this system is either evaporated on slag or used for electrode cooling. Since there are no organic contaminants present in this wastewater stream, concerns regarding leaching of contaminants from slag used in road construction were assumed to be not applicable. There may be very low levels of zinc present in the blowdown stream. There are concerns, however, regarding the transferability of the Cold Lime Softening technology. The application of this technology depends on the specific water chemistry at the mills. These modifications are shown in Figure 12.2 *Lake Ontario Steel Co. Applied BAT #2 Best in the United States*. The NCCW blowdown can be used as make-up to the process water system.

The capital and operating data for this treatment system are given in Table 12.3.



LAKE ONTARIO STEEL CO. - APPLIED BAT #1 - BEST IN ONTARIO
STRUCTURAL MILL
BAR MILL
BILLET CASTERS
SCALE PITS
OIL
COOLING POND
ROTARY STRAINERS
RETURN TO USERS
FILTERS
DISCHARGE TO LAKE
NEW BAT #1
NEW BAT #1
NCCW BLOWDOWN (MOVED FROM COOLING POND)
TO SOUTH POND
NOTE : IVACO ADVISE THAT THEY CANNOT MAINTAIN ZERO DISCHARGE AT THIS TIME, AND THEY INTEND TO DISCHARGE 0.26 – 1.00 m3/tonne.
FLOWRATE 190800 m3/day
BLOWDOWN FLOW 0.26 – 1.00 m3/tonne
RECYCLE RATE 99 %
LAKE ONTARIO STEEL COMPANY LTD
HATCH ASSOCIATES
1991-10-07
REV. 1

FIGURE 12.1



LAKE ONTARIO STEEL CO. - APPLIED BAT #2 - BEST IN THE UNITED STATES
STRUCTURAL MILL
BAR MILL
BILLET CASTERS
SCALE PITS
COOLING POND
OIL
SLAG COOLING &
ELECTRODE COOLING
(EVAPORATION)
80 m3/day
RETURN TO
USERS
ROTARY
STRAINERS
BACKWASH
2180 m3/day
NEW BAT #2
SODA ASH
HYDRATED LIME
RETURN TO
PROCESS
COLD LIME
SOFTENING
FILTRATE
SLUDGE
DEWATERING
SLUDGE
NCCW BLOWDOWN
(MOVED FROM
COOLING POND)
TO SOUTH POND
FLOWRATE
190800 m3/day
BLOWDOWN FLOW
80 m3/day
RECYCLE RATE
> 99 %
LAKE ONTARIO STEEL COMPANY LTD
HATCH ASSOCIATES
1991-10-07
REV. 1

FIGURE 12.2

PREDICTED EFFLUENT QUALITY

MINI MILLS – LASCO

BAT	EXISTING (Note 1)		BAT #1		BAT #2		BAT #3	BAT #4	BAT #5
Flow (m3/day)	6766		1708						
Parameter	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)			
TSS	9.7	66	10	17	No discharge to receiving water (Note 2).		See BAT #2.	See BAT #2.	See BAT #2.
oil and grease	2.3	15	5.0	8.5					
lead	0.052	0.35	–	–					
zinc	0.34	2.4	–	–					

Notes 1. Lasco data direct from MISA Monitoring Point #0100, South Pond. This effluent is 30% NCCW and 70% process water.

2. Nucor, Crawfordsville achieves no discharge to receiving water partly by evaporating blowdown on slag and partly by evaporation in electrode cooling.

1991-10-07	TABLE 12.1	HATCH ASSOCIATES	PEQMMLAS.WK1 PEQMMLAS.ALL	REV. # 2

TABLE 12.2 : MISA MODEL / APPLIED BAT COSTING				
Mill : Lake Ontario Steel Company Ltd.				
Subcategory : MINI MILLS				
BAT : 1				
Process Flow : 190800 M3/DAY Separate NCCW Blowdown Filtration System				
Date: 92/03/10			Filename: LASC-CB1.WK1	
1. Capital Costs				
(a) Engineering and Design				$14,000
(b) Equipment				$45,000
(c) Installation				$50,000
(d) Facilities and Structure				$43,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$56,000
Total Capital Cost				$208,000
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements	KWH	600000	$0.05	$30,000
Total Energy Requirements				$30,000
(b) Materials				
Total Materials				$0
(c) Operating Labour	MEN	0.5	$60,000	$30,000
(d) Maintenance	% of capital	5.00%		$10,000
TOTAL OPERATING & MAINTENANCE				$70,000
4. Disposal of Sludges or Solid Wastes				
(a) Quantities Generated per Unit Time		19	tonne/yr	$3,800
(b) Disposal Cost per Unit		200	$/tonne	
Comments:				

TABLE 12.3 : MISA MODEL / APPLIED BAT COSTING				
Mill : Lake Ontario Steel Corporation Subcategory : MINI MILLS BAT : 2 Process Flow : 190800 M3/DAY Cold lime softening Date: 92/03/10 Filename: LASC-CB2.WK1				
1. Capital Costs				
(a) Engineering and Design				$155,000
(b) Equipment				$483,000
(c) Installation				$521,000
(d) Facilities and Structure				$449,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$608,000
Total Capital Cost				$2,216,000
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements	kWh	87600	$0.05	$4,000
Total Energy Requirements				$4,000
(b) Materials				
Soda ash	Tonnes	436	$265.00	$116,000
Calcium Carbonate	Tonnes	145	$90.00	$13,000
Total Materials				$129,000
(c) Operating Labour	Manyears	0.5	$60,000	$30,000
(d) Maintenance	% of Capital	5.00%		$110,800
TOTAL OPERATING & MAINTENANCE				$274,000
4. Disposal of Sludges or Solid Wastes				
(a) Quantities Generated per Unit Time		2083	tonne/year	$417,000
(b) Disposal Cost per Unit		$200		
Comments:				

13.0 APPLIED BAT STELCO STEEL, HILTON WORKS

13.1 Cokemaking

13.1.1 BAT #1 Best in Ontario

Currently at Stelco Hilton Works, an ammonia still recovers and recycles ammonia from the process streams to the by-products plant. The still effluent is discharged to the sanitary sewer. Process water from the No. 1 and No. 2 interceptor sumps is directed to the East Side Filtration Plant then discharged. The pushing emissions control water from the wet electrostatic precipitators from #6 and #7 Coke batteries is currently discharged through the East Side Filtration Plant. Only the #6 and #7 coke batteries are equipped with pushing emissions control systems.

In order to upgrade this system to the BAT #1 effluent quality, a clarifier should be installed for the effluent from the wet electrostatic precipitators for solids removal prior to recirculation. The blowdown should be directed to the quench tower breeze basin.

Cost estimates have been prepared for treatment of the PEC water from the #6 and #7 coke batteries. No PEC systems exist on the other coke batteries and therefore no cost estimates were prepared.

The wastewater streams from the No. 1 and No. 2 interceptor sumps, waste ammonia liquor, phosam bottoms, and final cooler bottoms should be directed to a new equalization tank prior to the ammonia stills. In addition, a new gravel filter is required to filter waste ammonia liquor prior to equalization. A new ammonia still is required to increase the capacity of the system for the additional flow.

A two stage single sludge biological treatment system is required for treatment of the ammonia still effluent to oxidize phenols and nitrify ammonia. The biological treatment system consists of an off-line equalization tank and emergency lagoon, indirect heat exchangers on the feed to

the basins for cooling, aeration basins with steam injection (winter use only), a clarifier and a thickener for the waste activated sludge. There is a sludge handling system in place to permit the biosludge to be returned to the coke ovens via the coal conveyor. The clarifier overflow would be directed to a new Common Blowdown Treatment Plant for treatment of the Cokemaking, Ironmaking and Sintering blowdown wastewater streams. The treatment system should consist of equalization, metals precipitation, chlorination and filtration of the effluent prior to discharge. This treatment system is shown in Figure 13.1.1 *Stelco Hilton Works Cokemaking Applied BAT #1 Best in Ontario*. The cost of the blowdown treatments system has been apportioned based on flow contribution to the total Blowdown Treatment Plant flow.

The predicted effluent quality data sheet, Table 13.1.1, for the modified treatment system is attached. The capital and operating cost data for this treatment system are given in Tables 13.1.2 and 13.1.3.

13.1.2 BAT #2 Best in the United States

The modifications required to upgrade the system to a BAT #2 level of effluent quality are similar to the BAT #1 modifications except there is no Blowdown Treatment Plant. The treatment system modifications include a tar filter for the waste ammonia liquor, a new equalization tank, a spare ammonia still and a biological treatment plant with a clarifier and thickener for sludge handling. In applying the BAT #2 technology, a single secondary clarifier with a thickener for the underflow was determined to be sufficient for this application. A recirculation system on the PEC water at the #6 and #7 coke side sheds is also required. These modifications are described in more detail in Section 13.1.1 above. The cokemaking flowrate would be reduced to 0.54 m^3/tonne coke for applied BAT #2. This flow was calculated from the cokemaking effluent flow of 0.54 m^3/tonne at Inland Steel. The BAT #2 treatment system is shown in Figure 13.1.2 *Stelco Hilton Works Cokemaking Applied BAT #2 Best in the United States*.

The BAT #2 flow (Inland, IH, 0.54 m^3/tonne) does not include Light Oil Recovery nor indirect ammonia recovery. The EPA Development Document flow for Light Oil Recovery (0.10 m^3/tonne) was added to the BAT #2 flow for costing purposes. Stelco Hilton might have difficulty in achieving these flows because of the age of their facilities. Extensive work will be

required to prevent stormwater and other spills from being contaminated, thus requiring treatment.

The capital and operating cost data for this treatment system are given in Table 13.1.4 and 13.1.5.

13.1.3 BAT #3 Best at Selected World Locations

The best available cokemaking wastewater treatment technology was determined to be the BAT #1 system. The modifications required for applied BAT #1 are described in section 13.1.1.

13.1.4 BAT #4 Non-Lethal

The BAT #3 wastewater treatment technology for Cokemaking was determined to be the BAT #1 process. The applied BAT #1 modifications are outlined in section 13.1.1.

There is no specific toxicity data available for the disaggregated Cokemaking wastewater stream. However, based on an assessment of the expected effluent characteristics, specifically the single contaminant LC50 values, the effluent toxicity, as determined by the Ontario Toxicity Test, is probably marginal. The synergistic effects of the several contaminants in the effluent are not known and cannot be predicted. No demonstrated technologies are known to further reduce the concentrations of organic toxics to lower levels than those measured in this wastewater. The stream is likely to be co-treated with the Ironmaking and Sintering blowdown streams, and possibly combined with other streams prior to discharge to the receiving water. An accurate assessment of the toxicity of this unknown effluent cannot be made at this time.

13.1.5 BAT #5 Virtual Elimination of Persistent Toxics

The BAT #3 wastewater treatment technology for Cokemaking was determined to be the BAT #1 process. The applied BAT #1 modifications are outlined in section 13.1.1.

This wastewater stream is expected to contain very low levels of benzo(a)pyrene (persistent bioaccumulative) and other organic toxics. No demonstrated technologies are known to further reduce the concentrations of organic toxics. The precise scientific definition of "virtual elimination

of persistent toxics" is not established, but it is likely that this goal will be interpreted as zero discharge for persistent bioaccumulative toxics. Benzo(a)pyrene is listed in this category. No discharge to receiving water may be achieved with further treatment by ultrafiltration and ion exchange, or evaporation which may permit the treated water to be reused in other processes. However, these treatment technologies are not demonstrated in this application. Activated Carbon is a demonstrated treatment process for reduction of organics but its effectiveness to completely remove very low levels of carbon based contaminants is not known.

As outlined in Section 13.1.4 above, the treated effluent is unlikely to be discharged directly to the receiving waters. After co-treatment and/or combination with other streams, the resulting effluent will probably not meet the virtual elimination criteria because of the presence of persistent bioaccumulative toxics.

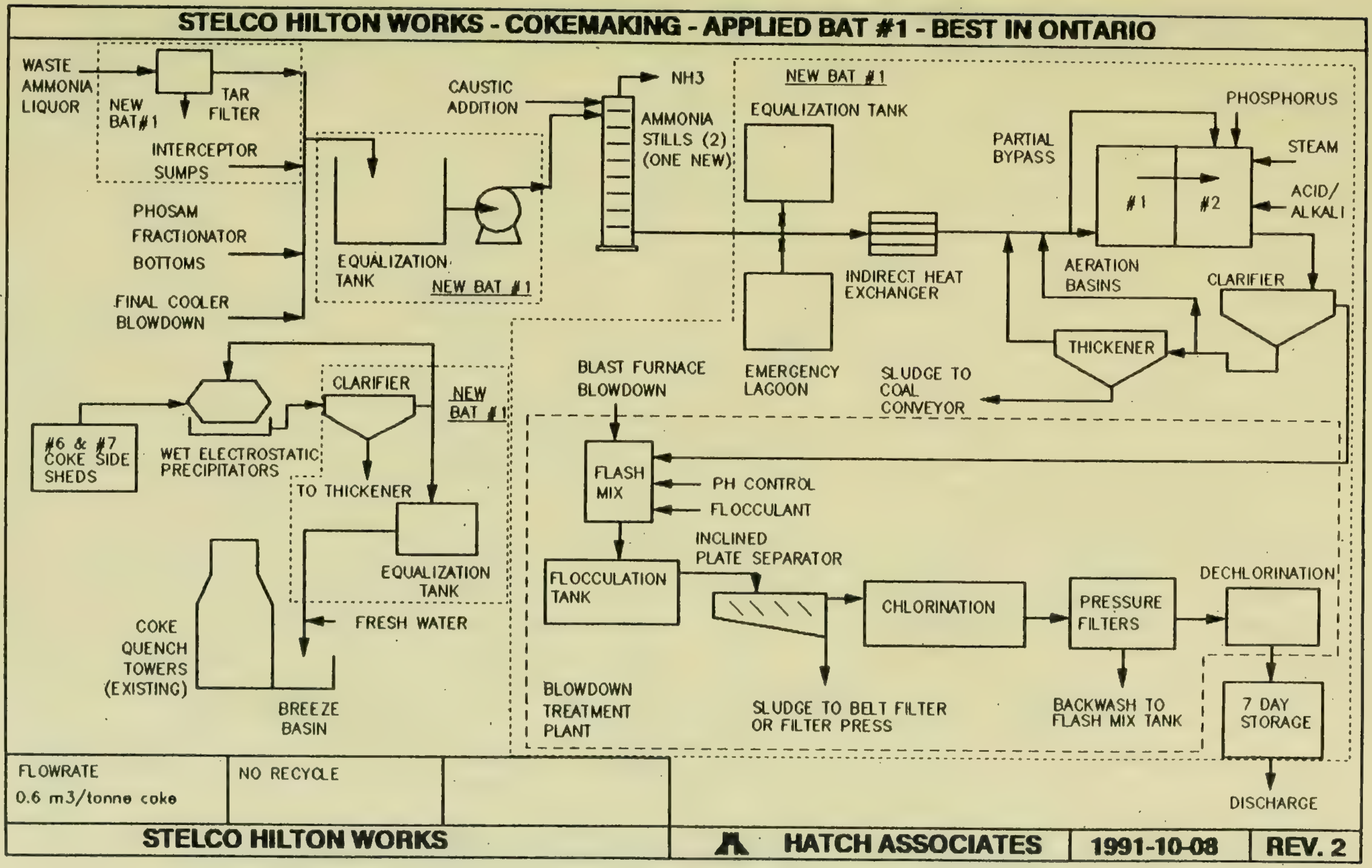

STELCO HILTON WORKS - COKEMAKING - APPLIED BAT #1 - BEST IN ONTARIO
WASTE AMMONIA LIQUOR
NEW BAT#1
TAR FILTER
INTERCEPTOR SUMPS
PHOSAM FRACTIONATOR BOTTOMS
FINAL COOLER BLOWDOWN
CAUSTIC ADDITION
EQUALIZATION TANK
NEW BAT #1
NH3
AMMONIA STILLS (2) (ONE NEW)
NEW BAT #1
EQUALIZATION TANK
EMERGENCY LAGOON
INDIRECT HEAT EXCHANGER
PARTIAL BYPASS
PHOSPHORUS
STEAM
ACID/ ALKALI
#1
#2
AERATION BASINS
CLARIFIER
THICKENER
SLUDGE TO COAL CONVEYOR
#6 & #7 COKE SIDE SHEDS
WET ELECTROSTATIC PRECIPITATORS
CLARIFIER
NEW BAT #1
TO THICKENER
EQUALIZATION TANK
FRESH WATER
COKE QUENCH TOWERS (EXISTING)
BREEZE BASIN
BLAST FURNACE BLOWDOWN
FLASH MIX
PH CONTROL
FLOCCULANT
INCLINED PLATE SEPARATOR
FLOCCULATION TANK
CHLORINATION
PRESSURE FILTERS
DECHLORINATION
7 DAY STORAGE
DISCHARGE
BLOWDOWN TREATMENT PLANT
SLUDGE TO BELT FILTER OR FILTER PRESS
BACKWASH TO FLASH MIX TANK
FLOWRATE
0.6 m3/tonne coke
NO RECYCLE
STELCO HILTON WORKS
HATCH ASSOCIATES
1991-10-08
REV. 2

FIGURE 13.1.1

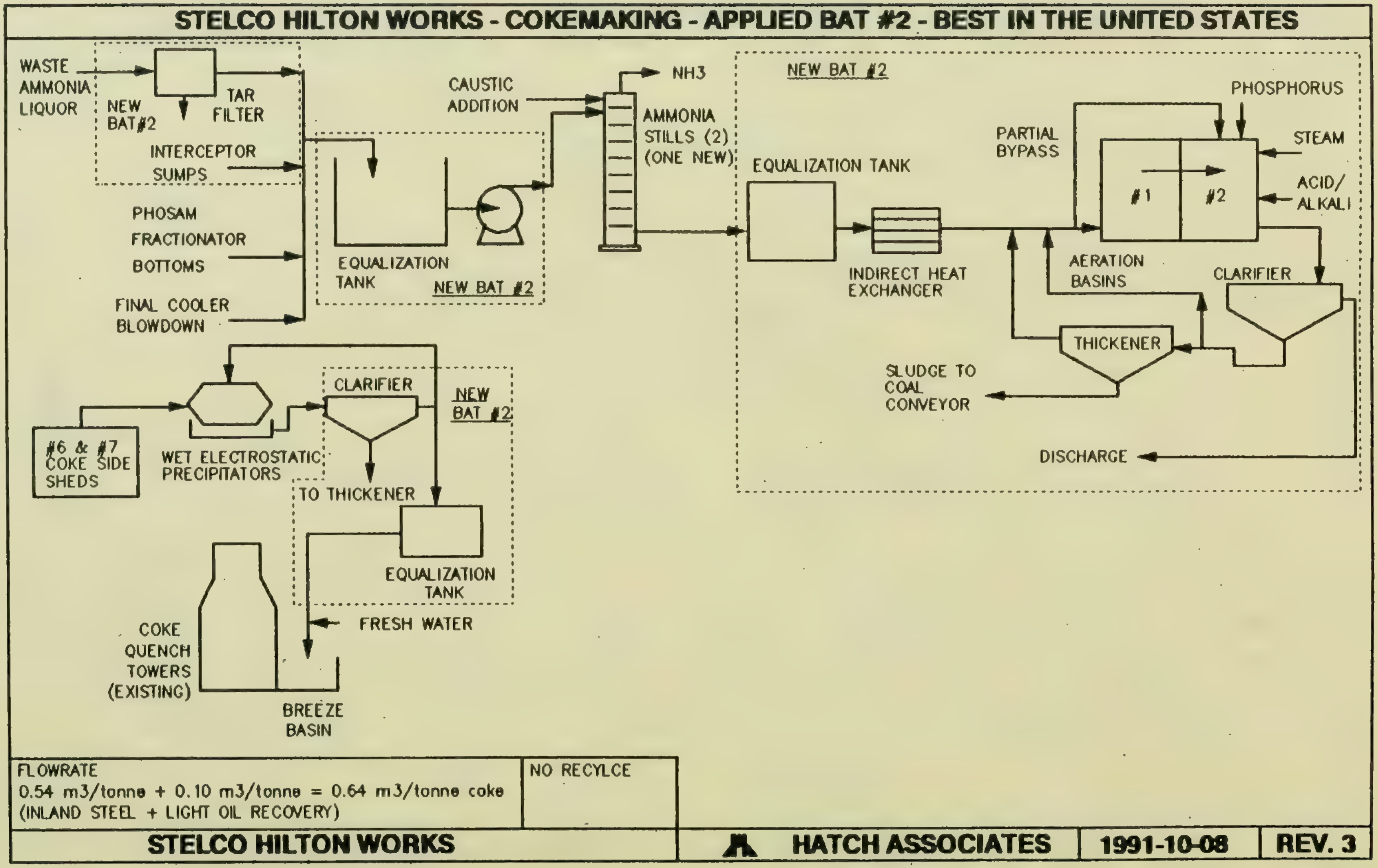

STELCO HILTON WORKS - COKEMAKING - APPLIED BAT #2 - BEST IN THE UNITED STATES
WASTE AMMONIA LIQUOR
NEW BAT#2
TAR FILTER
INTERCEPTOR SUMPS
PHOSAM FRACTIONATOR BOTTOMS
FINAL COOLER BLOWDOWN
EQUALIZATION TANK
NEW BAT #2
CAUSTIC ADDITION
NH3
AMMONIA STILLS (2) (ONE NEW)
NEW BAT #2
EQUALIZATION TANK
INDIRECT HEAT EXCHANGER
PARTIAL BYPASS
PHOSPHORUS
STEAM
ACID/ ALKALI
#1
#2
AERATION BASINS
CLARIFIER
THICKENER
SLUDGE TO COAL CONVEYOR
DISCHARGE
#6 & #7 COKE SIDE SHEDS
WET ELECTROSTATIC PRECIPITATORS
CLARIFIER
NEW BAT #2
TO THICKENER
EQUALIZATION TANK
FRESH WATER
COKE QUENCH TOWERS (EXISTING)
BREEZE BASIN
FLOWRATE
0.54 m3/tonne + 0.10 m3/tonne = 0.64 m3/tonne coke
(INLAND STEEL + LIGHT OIL RECOVERY)
NO RECYLCE
STELCO HILTON WORKS
HATCH ASSOCIATES
1991-10-08
REV. 3

FIGURE 13.1.2

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – COKEMAKING – STELCO HILTON WORKS

BAT	EXISTING	BAT #1		BAT #2 (Note 1)		BAT #3	BAT #4	BAT #5
Flow (m3/day)		1966		1769				
Parameter		Average Conc.	Average Loading	Average Conc.	Average Loading			
		(mg/L)	(kg/day)	(mg/L)	(kg/day)			
TSS		7.3	14	59	102			
oil and grease	Discharge to	1.4	2.8	1.3	2.3	See BAT #1.	See BAT #1.	No demonstrated
ammonia + ammonium	Hamilton STP.	* 0.17	0.33	1.7	3.0			technology in
cyanide total	No data	0.93	1.8	6.9	12			this industry
phenolics (4AAP)	available.	0.012	0.024	0.039	0.072			sector.
benzene		0.0052	0.010	0.0030	0.0049			
benzo(a)pyrene		0.010	0.020	0.021	0.036			
naphthalene		0.0062	0.012	0.011	0.019			

Notes: 1. The BAT #2 flow (Inland, IH, 0.54 m3/tonne) does not include Light Oil Recovery nor indirect ammonia recovery. The EPA Development Document flow for Light Oil Recovery (0.10 m3/tonne) was added to the BAT #2 flow for costing purposes. Stelco Hilton might have difficulty in achieving these flows because of the age of their facilities. Extensive work will be required to prevent stormwater and other spills from being contaminated, thus requiring treatment.

* less than RMDL

TABLE 13.1.2 STELCO HILTON WORKS

COKEMAKING APPL. BAT#1

FACILITIES	EST. CAP. COST $MM	EST. TYPE
Wastewater Handling System Upstream of Biological Plant		
• Tar Filter	1.09	C
• Equalization Tank	1.50	C
• Pumps feeding ammonia still	0.08	C
• One new ammonia stills	6.30	C
• Interconnecting services	2.13	B
Biological Plant	22.61	A
Blowdown Treatment Plant	3.62	A
Wastewater from Pushing Emissions Control Recycle System		
• Reactor Clarifier	2.39	C
• Polymer addition station	0.14	C
• Equalization sump tank	0.45	C
• Pumps	0.31	C
• Interconnecting Services	1.66	B
TOTAL	**42.28**	

Note: The cost for applying this BAT also includes $50,000 for a sludge slurry handling system.

TABLE 13.1.3 : MISA MODEL / APPLIED BAT COSTING

Mill : Stelco Hilton Works
Subcategory : Cokemaking
BAT : Applied BAT #1 (Best in Ontario)
Process Flow : 2026 m3/day
Date: 92/03/6 Filename: HILCM-CB.WK1

1. Capital Costs				
(a) Engineering and Design				$2,949,000
(b) Equipment				$9,634,000
(c) Installation				$10,306,000
(d) Facilities and Structure				$7,802,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$11,590,000
Total Capital Cost				**$42,281,000**
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements power	kWh	6608478	$0.05	$330,000
steam	tonne	4221	$15.00	$63,000
Total Energy Requirements				$393,000
(b) Materials nutrients				$47,000
polymer				$352,000
NaOH	kg	515464	$0.485	$250,000
H2SO4	kg	26828	$0.122	$3,000
chlorine	kg	67070	$0.375	$25,000
Total Materials				$677,000
(c) Operating Labour	manyears	12	$60,000	$720,000
(d) Maintenance	% of Capital	5.0%		$2,114,000
Total Operating and Maintenance				**$3,904,000**
4. Disposal of Sludges or Solid Wastes Increase over current operation.				
(a) Quantities Generated per Unit Time		80.3	tonne/year	$16,000
(b) Disposal Cost per Unit		$200	$/tonne	

Comments:

Sludge weight indicated on wet basis assuming 40% solids. Bioplant solids are disposed of on the coal pile and are not included. Steam allowance for light oil recovery, indirect ammonia recovery and run-off effluent flows are not included.

TABLE 13.1.4 STELCO HILTON WORKS

COKEMAKING APPL. BAT#2

FACILITIES	EST. CAP. COST $MM	EST. TYPE
Wastewater Handling System Upstream of B.P.		
• Tar Filter	1.17	C
• Equalization Tank	1.56	B
• Pumps feeding ammonia still	0.08	
• One new ammonia stills	6.71	
• Interconnecting Services	2.13	
Biological Plant	23.51	A
Wastewater from Pushing Emissions Control Recycle System		
• Equipment as in BAT #1	3.29	C
• Interconnecting Services	1.66	B
TOTAL	**40.11**	

NOTE: BAT#2 is similar to BAT#1 without the Blowdown Treatment Plant

TABLE 13.1.5 : MISA MODEL / APPLIED BAT COSTING

Mill :	Stelco Hilton Works			
Subcategory :	Cokemaking			
BAT :	Applied BAT #2 (Best in United States)			
Process Flow :	2161 m3/day			
Date:	92/03/6		Filename:	HILCM-CB.WK1

1. Capital Costs				
(a) Engineering and Design				$2,798,000
(b) Equipment				$9,160,000
(c) Installation				$9,794,000
(d) Facilities and Structure				$7,361,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$10,995,000
Total Capital Cost				$40,108,000
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements power	kWh	5775270	$0.05	$289,000
steam	tonne	4503	$15.00	$68,000
Total Energy Requirements				$357,000
(b) Materials nutrients				$50,000
polymer				$188,000
NaOH	kg	214624	$0.485	$104,000
H2SO4	kg	28616	$0.122	$3,000
chlorine	kg	71541	$0.375	$27,000
Total Materials				$372,000
(c) Operating Labour	manyears	6	$60,000	$360,000
(d) Maintenance	% of Capital	5.0%		$2,005,000
Total Operating and Maintenance				$3,094,000
4. Disposal of Sludges or Solid Wastes		Bioplant solids to coal pile.		
(a) Quantities Generated per Unit Time			tonne/year	No increase
(b) Disposal Cost per Unit			$/tonne	

Comments:

Steam allowance for light oil recovery, indirect ammonia recovery and run-off effluent flows are not included.

13.2 Sintering and Ironmaking

13.2.1 BAT #1 Best in Ontario

Sintering and Ironmaking wastewaters at Stelco's Hilton Works facility are integrated and interdependent.

The only Sintering wastewater treatment system in this industry sector in Ontario is at Stelco Hilton. As discussed in Volume I, sintering was not considered a category for the selection of BAT's in Ontario.

In order to upgrade the Ironmaking wastewater treatment system to maximize recycle and minimize blowdown in accordance with Model BAT #1, a cooling tower is required to permit increased water recirculation on Furnace "E", and a return line from the blast furnace underflow thickener to furnace "D" is required to minimize fresh water makeup. Blast furnace water should be used to replace fresh water where applicable such as gas seal water. The blowdown from these systems is directed to Furnace "E" thickener. Most of the overflow from the thickener is recirculated for gas cleaning. Some of the blowdown from the system is directed to the sinter plant on a once through basis, then discharged to the East Side Filtration Plant. In order to implement the recycle system for BAT #1 Hot Forming, the Sintering and Ironmaking wastewater must be diverted from the East Side Filtration Plant. The rest of the blowdown from the thickener is directed to a combined cokemaking, ironmaking and sintering wastewater treatment facility prior to discharge. The treatment system consists of equalization, metals precipitation, chlorination and filtration. Underflow from the Furnace "E" thickener is directed to the blast furnace underflow thickener. The underflow from this thickener is dewatered and the sludge is directed to the sinter plant. This treatment system is shown schematically in Figure 13.2.1 *Stelco Hilton Works Sintering & Ironmaking Applied BAT #2 Best in the United States*.

The zinc levels in the sludge will increase as a result of increased recirculation. It is likely that the zinc levels in the sludge will be too high for feed to the sinter plant. Thus, landfilling of this material will be required. An allowance of $1.4 million per year is included in the operating costs for this.

In applying the BAT #1 technology the blowdown from the Ironmaking water system is reduced, introducing a fresh water requirement at the Sinter Plant. Realistically, a recirculation system would also be installed on the Sinter Plant with blowdown to the blowdown treatment facility. For BAT #1 costing, the BAT #1 modification for Ironmaking and the BAT #2 modification for Sintering were used.

A water recirculation system could be installed on the slag pits to reduce or eliminate the discharge of wastewater from this source. Blowdown from the Ironmaking wastewater treatment system could be used as make up. However, in view of the Ministry's stated position that this process will not be approved, costs for this option have not been developed. (On the other hand, the Baywater effluent from slag quenching could be collected and recirculated).

The predicted effluent quality data sheets, Tables 13.2.1 and 13.2.2, for the modified treatment system are attached. The capital and operating cost data for this treatment system are given in Tables 13.2.3 and 13.2.4.

13.2.2 BAT #2 Best in the United States

In order to upgrade the Sintering wastewater treatment system to Model BAT #2, a recirculation system is required to minimize blowdown. To recirculate the water, Ph control and flocculation of the wastewater is required. The treated effluent is then directed to two thickeners for solids removal and recycled to the process. The blowdown from this system is directed to a blowdown treatment facility with the Ironmaking blowdown.

The BAT #2 Ironmaking wastewater treatment system is somewhat similar to the BAT #1 process. A cooling tower is required to recirculate water to the Furnace "E" gas cleaning system. Make up water to the Furnace "D" system is provided both from the Furnace "E" recirculation system, and from the overflow from the blast furnace underflow thickener. The Blowdown Treatment Plant consists of only a reactor clarifier and pressure filters. The Blowdown Treatment Plant is based on the High Density Sludge Treatment System at Bethlehem Steel, Sparrows Point. This is a patented system with partial recycle of the reactor clarifier underflow to the inlet of the clarifier. This is reported to improve solids removal in the reactor clarifier. This

treatment system is shown in Figure 13.2.2 *Stelco Hilton Works Sintering & Ironmaking Applied BAT #2 Best in the United States*.

The zinc levels in the sludge will increase as a result of increased recirculation. It is likely that the zinc levels in the sludge will be too high for feed to the sinter plant. Thus, land filling of this material will be required. An allowance of $1.4 million per year is included in the operating costs for this.

The capital and operating cost data for the BAT #2A treatment system are given in Tables 13.2.5 and 13.2.6.

13.2.3 BAT #3 Best at Selected World Locations

The best available Sintering wastewater treatment technology was determined to be the BAT #2 system. The modifications required for applied BAT #2 are described in section 13.2.2.

The best available Ironmaking wastewater treatment technology was determined to be the BAT #1 system. The modifications required for applied BAT #1 are described in section 13.2.1. The best available system for Stelco Hilton is that described for estimating purposes on BAT #1.

13.2.4 BAT #4 Non-Lethal

The BAT #3 wastewater treatment technology for Sintering and Ironmaking was determined to be the BAT #2 process for Sintering and the BAT #1 process for Ironmaking. The required modifications for applied BAT #1 and #2 are detailed in sections 13.2.1 and 13.2.2.

There is no toxicity data available for the BAT #3 Sintering and Ironmaking wastewater stream. However, based on an assessment of the effluent characteristics, specifically the single contaminant LC50 values, the Sintering and Ironmaking effluent is marginal to pass the Ontario Toxicity Test due to the ammonia and cyanide concentrations. The Sintering and Ironmaking blowdown streams are co-treated with the Cokemaking effluent and may be combined with other streams prior to discharge to the receiving water. Therefore, no reliable toxicity assessment can be made.

13.2.5 BAT #5 Virtual Elimination of Persistent Toxics

The BAT #3 wastewater treatment technology for Sintering and Ironmaking was determined to be the BAT #2 process for Sintering and the BAT #1 process for Ironmaking. The required modifications for applied BAT #1 and #2 are detailed in sections 13.2.1 and 13.2.2.

There are generally no known persistent bioaccumulative toxics present in sinter plant effluent. However, the Ironmaking wastewater stream is expected to contain very low levels (in some cases below RMDL) of organic compounds. No demonstrated technologies are known to further reduce the concentrations of the metal and organic toxics to lower levels than those measured in the wastewater stream. Virtual elimination of persistent toxics can only be assured by zero discharge. This may be achieved with further treatment by ultrafiltration and ion exchange, or evaporation which may permit the treated water to be recycled to the process. However, these treatment technologies are not demonstrated in this application.

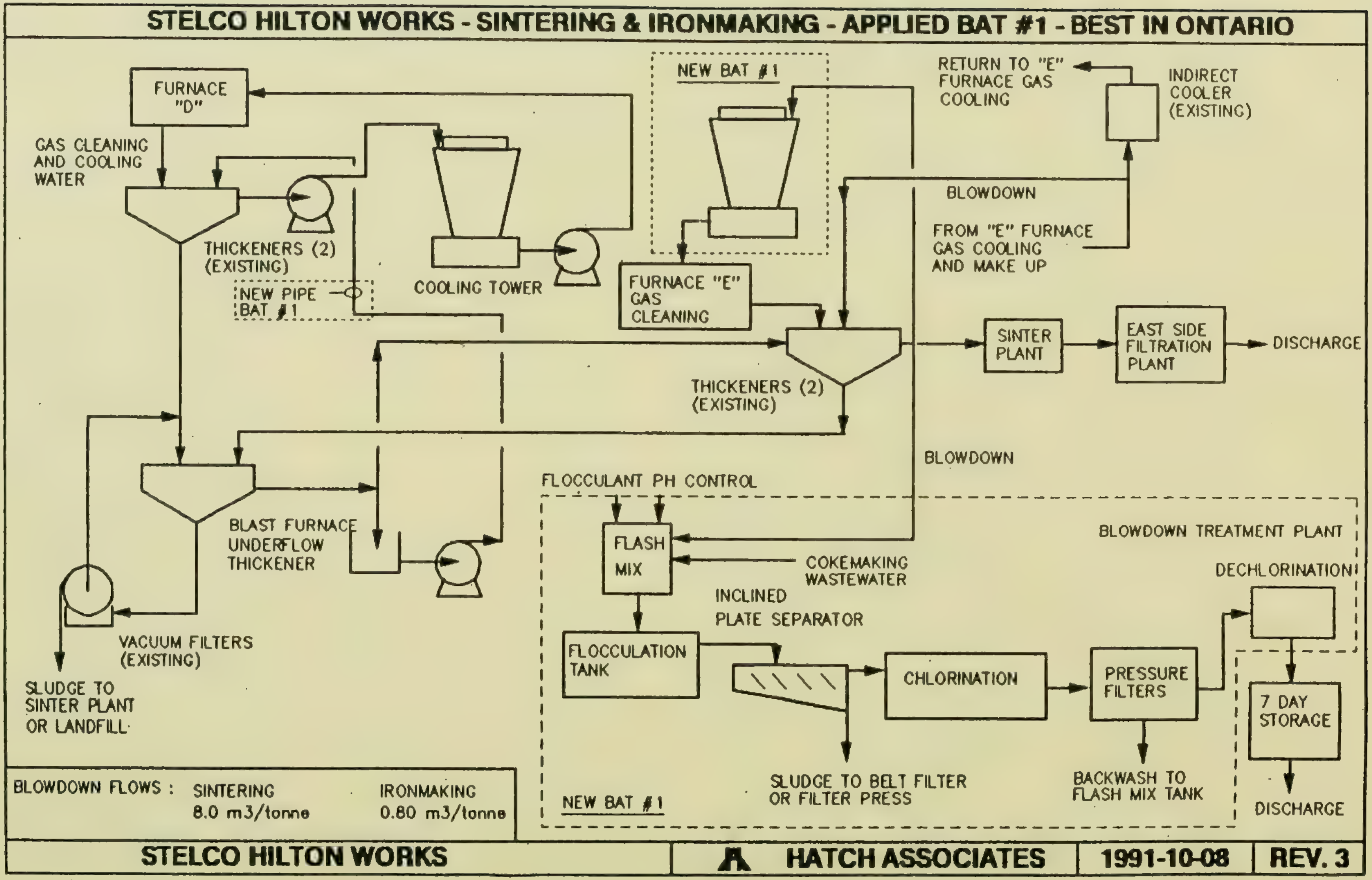
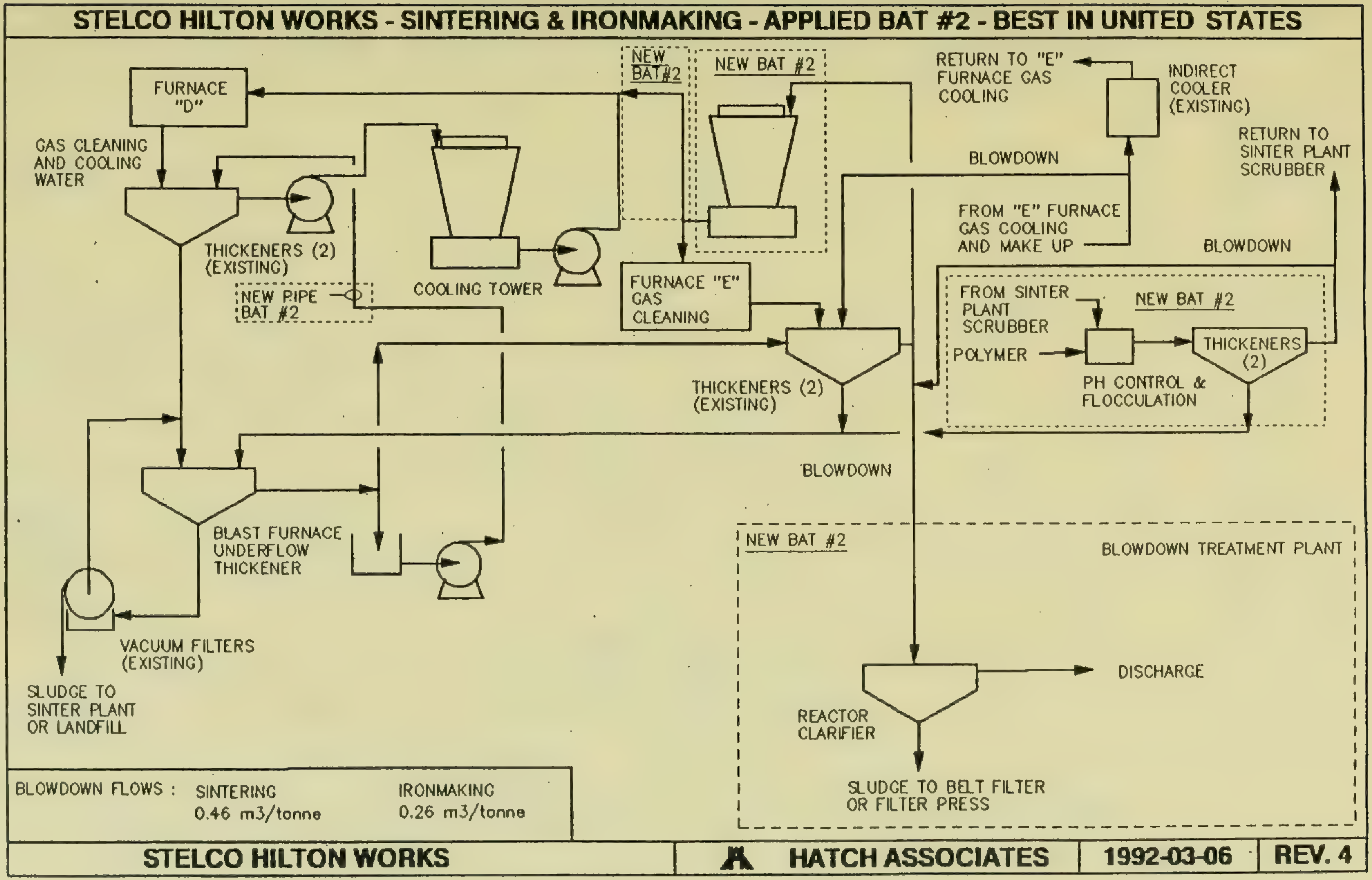

STELCO HILTON WORKS - SINTERING & IRONMAKING - APPLIED BAT #1 - BEST IN ONTARIO
FURNACE "D"
GAS CLEANING AND COOLING WATER
THICKENERS (2) (EXISTING)
NEW PIPE BAT #1
COOLING TOWER
NEW BAT #1
FURNACE "E" GAS CLEANING
RETURN TO "E" FURNACE GAS COOLING
INDIRECT COOLER (EXISTING)
BLOWDOWN
FROM "E" FURNACE GAS COOLING AND MAKE UP
SINTER PLANT
EAST SIDE FILTRATION PLANT
DISCHARGE
THICKENERS (2) (EXISTING)
BLOWDOWN
BLAST FURNACE UNDERFLOW THICKENER
VACUUM FILTERS (EXISTING)
SLUDGE TO SINTER PLANT OR LANDFILL
FLOCCULANT PH CONTROL
FLASH MIX
COKEMAKING WASTEWATER
INCLINED PLATE SEPARATOR
FLOCCULATION TANK
CHLORINATION
PRESSURE FILTERS
BLOWDOWN TREATMENT PLANT
DECHLORINATION
7 DAY STORAGE
DISCHARGE
SLUDGE TO BELT FILTER OR FILTER PRESS
BACKWASH TO FLASH MIX TANK
NEW BAT #1
BLOWDOWN FLOWS : SINTERING 8.0 m3/tonne IRONMAKING 0.80 m3/tonne
STELCO HILTON WORKS
HATCH ASSOCIATES
1991-10-08
REV. 3

FIGURE 13.2.1



STELCO HILTON WORKS - SINTERING & IRONMAKING - APPLIED BAT #2 - BEST IN UNITED STATES
FURNACE "D"
GAS CLEANING AND COOLING WATER
THICKENERS (2) (EXISTING)
NEW PIPE BAT #2
COOLING TOWER
NEW BAT #2
NEW BAT #2
FURNACE "E" GAS CLEANING
THICKENERS (2) (EXISTING)
RETURN TO "E" FURNACE GAS COOLING
INDIRECT COOLER (EXISTING)
BLOWDOWN
RETURN TO SINTER PLANT SCRUBBER
FROM "E" FURNACE GAS COOLING AND MAKE UP
BLOWDOWN
FROM SINTER PLANT SCRUBBER
NEW BAT #2
POLYMER
THICKENERS (2)
PH CONTROL & FLOCCULATION
BLOWDOWN
BLAST FURNACE UNDERFLOW THICKENER
VACUUM FILTERS (EXISTING)
SLUDGE TO SINTER PLANT OR LANDFILL
NEW BAT #2
BLOWDOWN TREATMENT PLANT
DISCHARGE
REACTOR CLARIFIER
SLUDGE TO BELT FILTER OR FILTER PRESS
BLOWDOWN FLOWS : SINTERING 0.46 m3/tonne IRONMAKING 0.26 m3/tonne
STELCO HILTON WORKS
HATCH ASSOCIATES
1992-03-06
REV. 4

FIGURE 13.2.2

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – SINTERING – STELCO HILTON WORKS

BAT	EXISTING	BAT #1	BAT #2A (Note 1)		BAT #2B		BAT #2C	BAT #3	BAT #4	BAT #5
Flow (m3/day)	9700		11		558					
Parameter			Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)				
TSS			13	0.15	8.6	4.9				
oil and grease	Flow combined with	Not	13	0.15	5.9	3.3	Dry Gas	See BAT #3	See BAT #4	No demonst.
ammonia + ammonium	other process flows.	applicable.	85	0.94	62	34	Cleaning,	Ironmaking	Ironmaking	technology
cyanide total	No data available.		0.21	0.0024	0.14	0.078	no effluent.	Stelco	Stelco	in this
phenolics (4AAP)			0.012	0.00014	0.083	0.046		Hilton.	Hilton.	Industry
lead			0.054	0.00060	0.019	0.011				sector.
zinc			1.2	0.0134	0.20	0.11				

Notes: 1. Blowdown evaporated on slag. This option was not costed.

1992-02-12	TABLE 13.2.1	HATCH ASSOCIATES	PEQSNHIL.WK1 PEQSNHIL.ALL	REV. # 3

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – IRON MAKING – STELCO HILTON

BAT	EXISTING	BAT #1		BAT #2A		BAT #2B	BAT #3	BAT #4	BAT #5
Flow (m3/day)		4287		1393					
Parameter		Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)				
TSS		* 4.9	21	8.6	12				
oil and grease	Flow sent to Sinter	–	–	–	–	No effluent	See BAT #1.	See BAT #1.	No demonstr.
ammonia + ammonium	Plant and then	0.52	2.2	62	86	to receiving			technology
cyanide total	combined with other	0.47	2.0	0.14	0.19	water –			in this
phenolics (4AAP)	process flows.	0.012	0.053	0.083	0.12	slag			industry
lead	No data available.	* 0.022	0.096	0.019	0.026	evaporation.			sector.
zinc		0.045	0.19	0.20	0.28				

* less than RMDL

TABLE 13.2.3 STELCO HILTON WORKS

SINTERING AND IRONMAKING APPL.BAT#1

FACILITIES	EST. CAP. COST $MM	EST. TYPE
Recycled blast furnace water on gas seals		
• Internal piping modifications	0.46	B
• Return line to "D" furnace to minimize make-up	0.80	B
• Pumps c/w surge tank	0.61	C
"E" Furnace Cooling Tower		
• Cooling tower	1.51	C
• Basin overflow pumps c/w surge tank	1.78	C
• Pipeline from furnace "E" thickeners to cooling tower and return	0.69	B
Blowdown Treatment Plant*		
• Blowdown pumps	0.23	C
• Pipeline from fce. "E" scrubber to B.T.P.	0.80	B
• Blowdown Treatment Plant	12.87	A
• Sinter plant recycle as per BAT 2	4.45	C
TOTAL	**24.20**	

* This is not a stand alone cost.

Note: Collection and recirculation of slag pit wastewater is not included in the above costs. Stelco advises us that a capital expenditure of $2 million would be required.

TABLE 13.2.4 : MISA MODEL / APPLIED BAT COSTING				
Mill :	Stelco Hilton Works			
Subcategory :	Sintering and Ironmaking			
BAT :	Applied BAT #1 (Best in Ontario)			
Process Flow :	7127 m3/day (excluding Sintering)			
Date:	92/03/10		Filename:	HILSI-CB.WK1
1. Capital Costs				
(a) Engineering and Design				$1,690,000
(b) Equipment				$5,534,000
(c) Installation				$5,917,000
(d) Facilities and Structure				$4,443,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$6,640,000
Total Capital Cost				$24,224,000
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements power	kWh	14002000	$0.05	$700,000
Total Energy Requirements				$700,000
(b) Materials NaOH	kg	707800	$0.485	$343,000
H2SO4	kg	94400	$0.122	$12,000
chlorine	kg	236000	$0.375	$89,000
polymer				$620,000
Total Materials				$1,064,000
(c) Operating Labour	manyears	8	$60,000	$480,000
(d) Maintenance	% of Capital	5.0%		$1,211,000
Total Operating & Maintenance				$3,455,000
4. Disposal of Sludges or Solid Wastes Increase over current operation.				
(a) Quantities Generated per Unit Time			allowance	$1,400,000
(b) Disposal Cost per Unit				

Comments:

Existing effluent data not available for Ironmaking as flow is combined with other streams and sent to Sinter Plant. Minor increase in solids production expected as Ironmaking flow is diverted from Sinter Plant to Blowdown Treatment Plant.

TABLE 13.2.5 STELCO HILTON WORKS

SINTERING AND IRONMAKING APPL. BAT#2

FACILITY	EST. CAP. COST $MM	EST. TYPE
Pipeline to send blow-down from furnace "E" to "D"	1.45	B
Sinter Plant Recycle		
New thickener for recycling sinter plant scrubbing water (two required) c/w sludge pumps and polymer addition station. Also PH adjustment and floculation ahead of thickener.	3.50	B
Scrubber effluent and thickner overflow pumping station	0.95	B
Interconnecting Services		
• Pipelines from existing Sinter Plant scrubber to new thickener and back	0.61	B
• Pipe for sludge from new thickeners to existing Blast Furnace thickener	0.3	B
• Blowdown from new Sinter Plant thickener to furnace "E" gas cleaning system	0.46	B
Blowdown Treatment Plant		
• Equipment (clarifier, pumps, sludge dewatering)	3.19	B
• Interconnecting Services	2.39	B
COSTS FROM BAT 1 ITEMS E furnace cooling tower BDTP blow down pumps	4.23	B
TOTAL	**17.15**	

TABLE 13.2.6 : MISA MODEL / APPLIED BAT COSTING				
Mill : Stelco Hilton Works Subcategory : Sintering and Ironmaking BAT : Applied BAT #2 (Best in United States) Process Flow : 1350 m3/day Date: 92/03/10 Filename: HILSI-CB.WK1				
1. Capital Costs				
(a) Engineering and Design				$1,196,000
(b) Equipment				$4,501,000
(c) Installation				$4,679,000
(d) Facilities and Structure				$2,073,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$4,701,000
Total Capital Cost				$17,150,000
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements power	kWh	20487100	$0.05	$1,024,000
Total Energy Requirements				$1,024,000
(b) Materials polymer				$8,000
NaOH	kg	214497	$0.485	$104,000
H2SO4	kg	28600	$0.122	$3,000
chlorine	kg	71499	$0.375	$27,000
Total Materials				$142,000
(c) Operating Labour	manyears	4	$60,000	$240,000
(d) Maintenance	% of Capital	5.0%		$858,000
Total Operating & Maintenance				$2,264,000
4. Disposal of Sludges or Solid Wastes Increase over current operation.				
(a) Quantities Generated per Unit Time			allowance	$1,400,000
(b) Disposal Cost per Unit				

Comments:

Existing effluent data not available for Ironmaking as flow is combined with other streams and sent to Sinter Plant.

13.3 Steelmaking

Stelco Hilton Works has a dry gas cleaning system on their Basic Oxygen Furnaces, therefore, no wastewater is generated.

The predicted effluent quality data sheet is given in Table 13.3.1, for the record.

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – STEELMAKING – STELCO HILTON

BAT	EXISTING	BAT #1	BAT #2	BAT #3	BAT #4	BAT #5
Flow (m3/day)						
Parameter						
TSS oil and grease lead zinc	Dry Gas Cleaning, no effluent (Note 1).	See existing.	See existing.	See existing.	See existing.	See existing.

Notes: 1. Stelco Hilton has an open combustion BOF system with dry gas cleaning.

1991-10-07	TABLE 13.3.1	HATCH ASSOCIATES	PEQSMHIL.WK1 PEQSMHIL.ALL	REV. # 2

13.4 Continuous Casting and Hot Forming

13.4.1 BAT #1 Best in Ontario

In order to achieve a BAT #1 level of effluent quality, a new cooling tower is required to recycle the Hot Forming wastewater from the East Side Filtration Plant. In addition, a backwash thickener and vacuum filter are required for the filter plant backwash. Separate recirculation systems are required for the Continuous Caster and the Z line. This treatment system is shown in Figure 13.4.1 *Stelco Hilton Works Hot Forming & Continuous Casting Applied BAT #1 Best in Ontario*.

In order to accomplish recycle of Hot Forming and Continuous Casting wastewater to the processes an extensive retrofit is required to mill water supply systems to separate the recycle water from the Bay Water Ring Main. Within each mill facility further major retrofit costs are required to permit recycle water to be used in the process. These are as follows:

- Hot Forming wastewater recycle system
- Closed Loop recycle on the Caster System
- Closed Loop recycle on the "Z" line.

In addition, the following changes are required:

- re-routing west side effluents, and Finishing Mill process and non-contact cooling water;
- installation of back-up pumping requirements, including diesel generators;
- pumping of turbo-blow condenser water back to the bay on the West side;
- modifications to ensure the security of supply in the rest of the Bay Water network;
- make-up water supply lines to ensure #3 B&B has source of make-up water;
- chemical feed systems to ensure that correct water chemistry is maintained in the recirculating system.

The predicted effluent quality data sheets, Tables 13.4.1 and 13.4.2, for the modified treatment system are attached. The capital and operating data for this treatment system are given in Tables 13.4.3 and 13.4.4.

The costs of re-routing west side effluent, and Finishing Mill process and non-contact cooling water are included in their respective BAT costings and not duplicated in Hot Forming costs.

In addition, Stelco has commented that the following items would likely also form part of a modified system:

- Pump blast furnace turbo-blower condenser water back to the west side;
- Scope to retain security of supply in the rest of the Baywater network; and,
- Chemical feed systems to ensure that correct water chemistry is maintained in the newly created recirculating process water systems.

13.4.2 BAT #2 Best in the United States

The BAT #2 modifications are the same as the BAT #1 modifications with the blowdown flow reduced to 0.076 m^3/tonne from the Continuous Casting system and 0.36 m^3/tonne from Hot Forming.

13.4.3 BAT #3 Best at Selected World Locations

The best available treatment technology for Continuous Casting and Hot Forming wastewater was determined to be the BAT #2 process. The required modifications for applied BAT #2 are detailed in section 13.4.2.

13.4.4 BAT #4 Non-Lethal

The BAT #3 wastewater treatment technology for Continuous Casting and Hot Forming was determined to be the BAT #2 process. The applied BAT #2 modifications are outlined in section 13.4.2.

There is no specific toxicity data available for the co-treated Continuous Casting and Hot Forming wastewater stream. However, based on a review of predicted effluent concentrations,

low levels of lead and zinc will be present in the Continuous Casting wastewater. Based on testing of the Hot Forming Wastewater, the Hot Forming effluent is expected to pass the Ontario Toxicity Test. An accurate assessment of the toxicity of the co-treated stream can not be made at this time.

13.4.5 BAT #5 Virtual Elimination of Persistent Toxics

The BAT #3 wastewater treatment technology for Continuous Casting and Hot Forming was determined to be the BAT #2 process. The applied BAT #2 modifications are outlined in section 13.4.2.

As discussed in Section 13.4.4 above, low levels of lead and zinc are present in the Continuous Casting effluent. The lead and zinc concentrations will be reduced to extremely low levels in the co-treated Continuous Casting and Hot Forming effluent. No demonstrated technologies are known to further reduce the concentrations of these compounds. Virtual elimination of persistent toxics can only be assured by zero discharge. This may be achieved with further treatment by ultrafiltration and ion exchange, or evaporation which may permit the treated water to be recycled to the process. However, these treatment technologies are not demonstrated in this application.

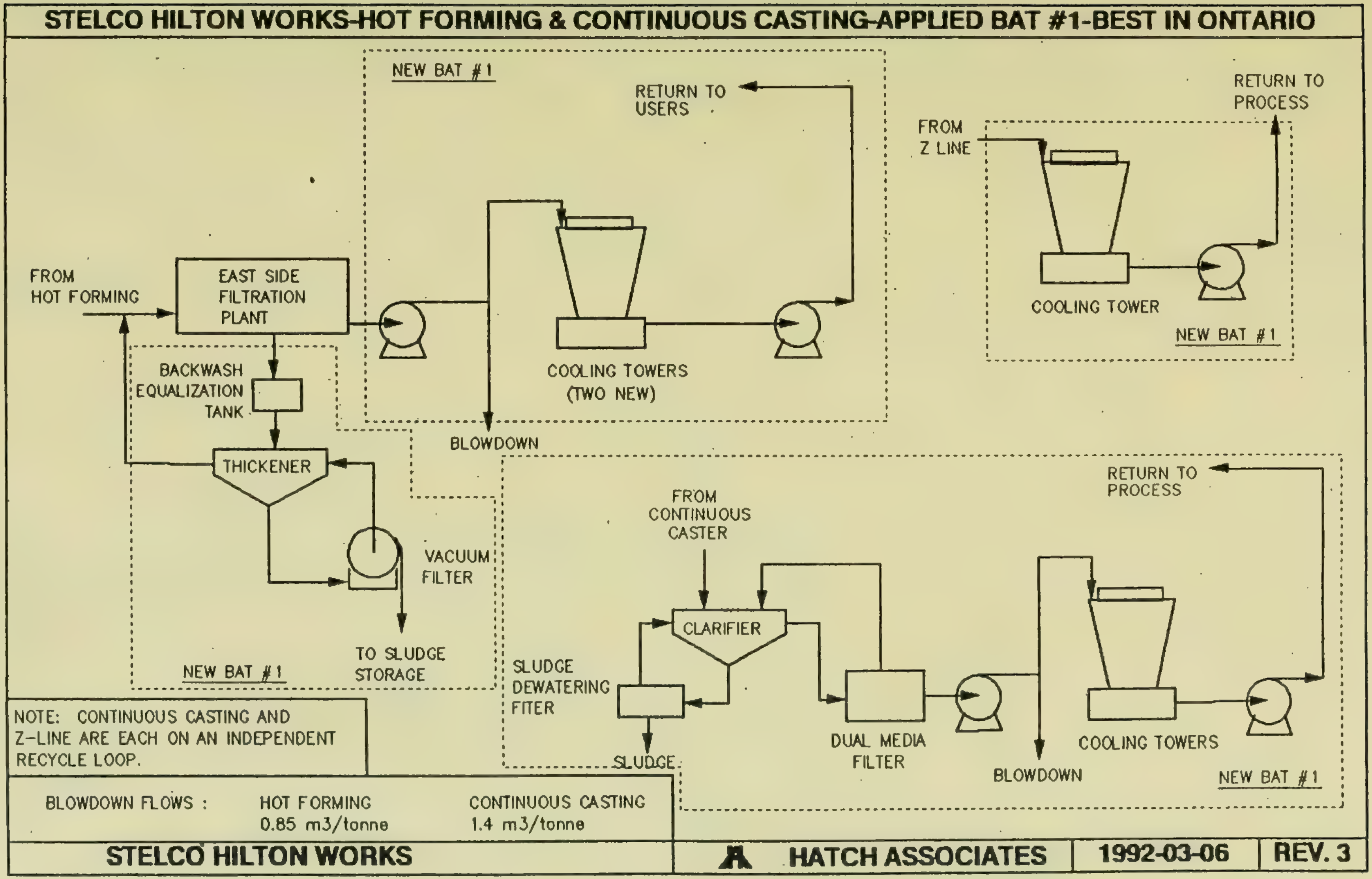

STELCO HILTON WORKS-HOT FORMING & CONTINUOUS CASTING-APPLIED BAT #1-BEST IN ONTARIO
NEW BAT #1
RETURN TO USERS
FROM HOT FORMING
EAST SIDE FILTRATION PLANT
COOLING TOWERS (TWO NEW)
BLOWDOWN
BACKWASH EQUALIZATION TANK
THICKENER
VACUUM FILTER
TO SLUDGE STORAGE
NEW BAT #1
FROM Z LINE
RETURN TO PROCESS
COOLING TOWER
NEW BAT #1
FROM CONTINUOUS CASTER
CLARIFIER
SLUDGE DEWATERING FITER
SLUDGE
DUAL MEDIA FILTER
BLOWDOWN
COOLING TOWERS
RETURN TO PROCESS
NEW BAT #1
NOTE: CONTINUOUS CASTING AND Z-LINE ARE EACH ON AN INDEPENDENT RECYCLE LOOP.
BLOWDOWN FLOWS :
HOT FORMING 0.85 m3/tonne
CONTINUOUS CASTING 1.4 m3/tonne
STELCO HILTON WORKS
HATCH ASSOCIATES
1992-03-06
REV. 3

FIGURE 13.4.1

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – CONTINUOUS CASTING – STELCO HILTON

BAT	EXISTING	BAT #1		BAT #2		BAT #3	BAT #4	BAT #5
Flow (m3/day)		6370		346				
Parameter		Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)			
TSS	No data available (Flows to ESFP).	* 4.9	30	21	6.4	See BAT #2.	See BAT #2.	No demonstrated technology in this industry sector.
oil and grease		1.4	9.1	1.8	0.73			
lead		–	–	0.13	0.040			
zinc		–	–	0.11	0.036			

* less than RMDL

1991-10-07	TABLE 13.4.1	HATCH ASSOCIATES	PEQCCHIL.WK1 PEQCCHIL.ALL	REV. # 3

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – HOT FORMING – STELCO HILTON (Note 1)

BAT	EXISTING	BAT #1 (Note 2)		BAT #2 (Note 2)		BAT #3	BAT #4	BAT #5
Flow (m3/day)		5512		2335				
Parameter		Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)			
TSS	Effluent sent to ESFP.	* 4.9	27	2.9	7.1			
oil and grease	No data available.	6.3	34	7.1	15	See BAT #2.	See BAT #2.	Not applicable.

Notes: 1. This table refers Hot Forming Operations excluding the #3 Bloom and Billet Mill and the No. 2 Rod Mill (Universal Slabbing Mill, 148″ Plate Mill, Hot Strip Mill and No. 1 Bar Mill).

2. Calculations based on the total production from the Universal Slabbing Mill, the 148″ Plate Mill, the Hot Strip Mill and the No. 1 Bar Mill.

* less than RMDL

1992-02-12	TABLE 13.4.2	HATCH ASSOCIATES	PEQHFHIL.WK1 PEQHFHIL.ALL	REV. # 3

TABLE 13.4.3 STELCO HILTON WORKS

HOT FORMING AND CONTINUOUS CASTING APPL. BAT#1

FACILITIES	EST. CAP. COST $MM	EST. TYPE
Recycle East Side Filter Plant Effluent		
• Cooling Towers (two required)	15.40	C
• Piping from cooling towers to users:	18.12	B
• Z-line recycle loop(cooling tower etc.)	3.08	C
• Caster recycle loop(cooling tower etc.)	3.90	C
• ESFP backwash treatment	9.38	B
• Cooling tower hot and cold wells	11.49	B
• Cooling towers pumping stations (pumps-in and-out c/w pit)	4.73	B
• Additional power supply including cable	0.76	B
• Back-up diesel generator	7.68	C
TOTAL	**74.54**	

Note: Stelco advises that the following items, not included in the above, would likely also form part of a modified system:

-pump blast furnace turbo-blower condenser water back to the west side;

-scope to retain security of supply in the rest of the Baywater network; and

-chemical feed systems to ensure that correct water chemistry is maintained in the newly created recirculating process water systems.

TABLE 13.4.4 : MISA MODEL / APPLIED BAT COSTING				
Mill : Stelco Hilton Works Subcategory : Hot Forming & Continuous Casting BAT : Applied BAT #1 Process Flow : 505853 m3/day Date: 92/02/19			Filename:	HILHF-CB.WK1
1. Capital Costs				
(a) Engineering and Design				$5,199,000
(b) Equipment				$18,326,000
(c) Installation				$19,296,000
(d) Facilities and Structure				$11,283,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$20,431,000
Total Capital Cost				$74,535,000
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements power	kWh	1.3E+08	$0.05	$6,747,000
Total Energy Requirements				$6,747,000
(b) Materials				
reagents				$430,000
Total Materials				$430,000
(c) Operating Labour	manyears	8	$60,000	$480,000
(d) Maintenance	% of Capital	5.0%		$3,727,000
Total Operating & Maintenance				$11,384,000
4. Disposal of Sludges or Solid Wastes		Data not available.		
(a) Quantities Generated per Unit Time			tonne/year	
(b) Disposal Cost per Unit			$/tonne	

Comments:

No data available for existing Hot Forming & Continuous Casting effluent streams.

13.5 No. 3 Bloom and Billet Mill

13.5.1 BAT #1 Best in Ontario

In order to achieve a BAT #1 level of effluent quality, a cooling tower is required to recycle the Hot Forming wastewater from the Filtration Plant. In addition, a backwash thickener and a vacuum filter are required for the filter backwash. A separate water supply header the length of the mill is also required to feed NCCW users. These modifications are shown in Figure 13.5.1 *Stelco Hilton Works No. 3 Bloom and Billet Mill Applied BAT #1 Best in Ontario.*

The predicted effluent quality data sheet, Table 13.5.1, for the modified treatment system is attached. The capital and operating data for this treatment system are given in Tables 13.5.2 and 13.5.3.

13.5.2 BAT #2 Best in the United States

The BAT #2 modifications are the same as the BAT #1 modifications with the blowdown flow reduced to 0.36 m^3/tonne.

13.5.3 BAT #3 Best at Selected World Locations

The best available treatment technology for the Hot Forming wastewater was determined to be the BAT #2 process. The required modifications for applied BAT #2 are detailed in section 13.5.2.

13.5.4 BAT #4 Non-Lethal

The BAT #3 wastewater treatment technology for Hot Forming was determined to be the BAT #2 process. The applied BAT #2 modifications are outlined in section 13.5.2.

Based on toxicity testing during the MISA monitoring period at the No. 3 Bloom and Billet Mill, the current effluent passes the Ontario Toxicity Test. Further reduction in the blowdown will increase dissolved solids in the effluent. Based on USEPA data, the reduced blowdown stream will probably pass the Ontario Toxicity Test, however, toxicity testing on the reduced blowdown stream is required to confirm this. This stream is discharged directly to the receiving water.

13.5.5 BAT #5 Virtual Elimination of Persistent Toxics

The BAT #3 wastewater treatment technology for Hot Forming was determined to be the BAT #2 process. The applied BAT #2 modifications are outlined in section 13.5.2.

Hot forming wastewater streams do not normally contain toxic metals or organics. Virtual elimination of persistent toxics is therefore not a requirement in this case and BAT #5 is not applicable.

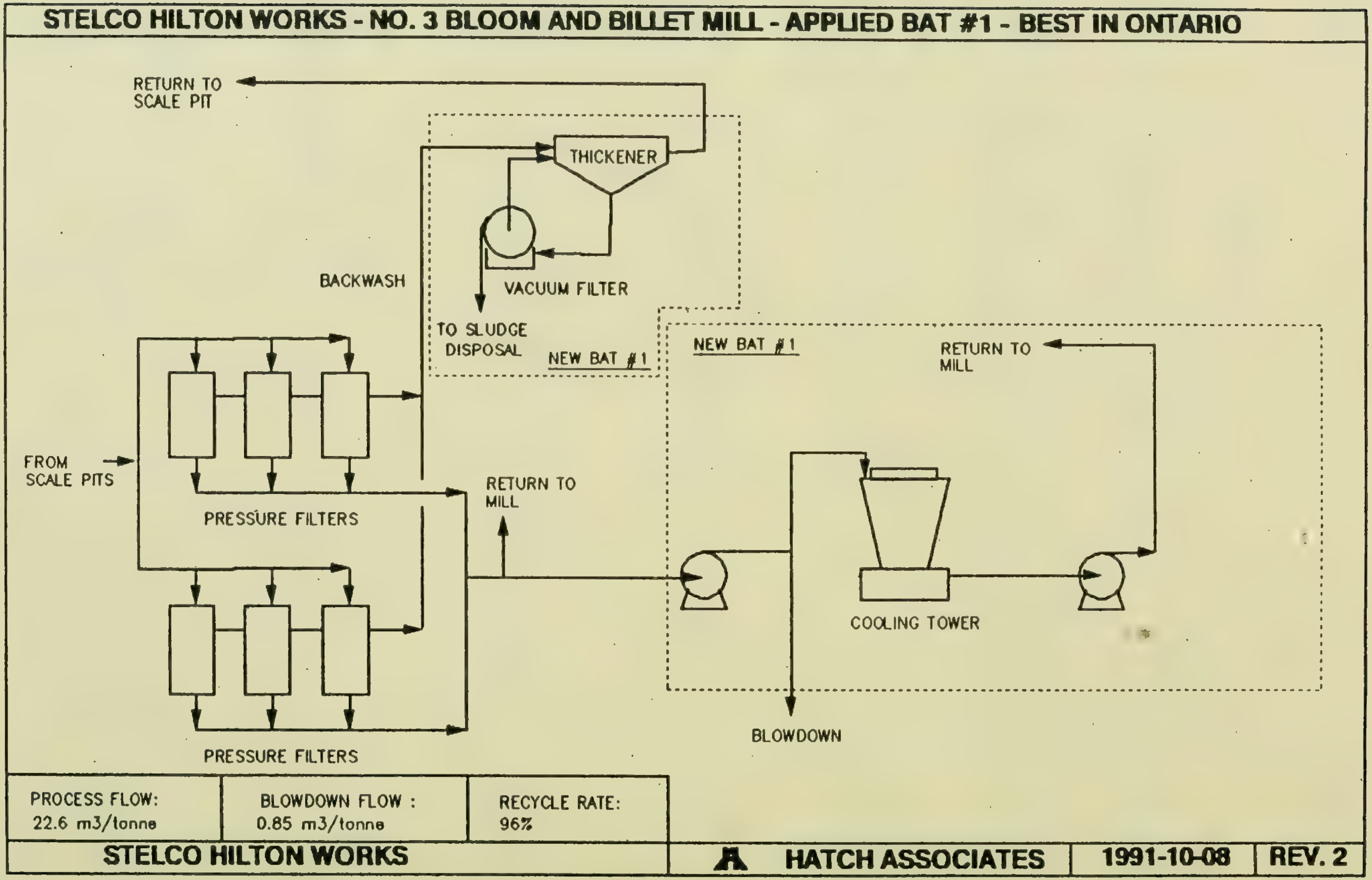

STELCO HILTON WORKS - NO. 3 BLOOM AND BILLET MILL - APPLIED BAT #1 - BEST IN ONTARIO
RETURN TO SCALE PIT
THICKENER
BACKWASH
VACUUM FILTER
TO SLUDGE DISPOSAL
NEW BAT #1
NEW BAT #1
RETURN TO MILL
FROM SCALE PITS
RETURN TO MILL
PRESSURE FILTERS
COOLING TOWER
BLOWDOWN
PRESSURE FILTERS
PROCESS FLOW: 22.6 m3/tonne
BLOWDOWN FLOW : 0.85 m3/tonne
RECYCLE RATE: 96%
STELCO HILTON WORKS
HATCH ASSOCIATES
1991-10-08
REV. 2

FIGURE 13.5.1

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – HOT FORMING – STELCO HILTON – #3 BLOOM AND BILLET MILL

BAT	EXISTING (Note 1)		BAT #1		BAT #2		BAT #3	BAT #4	BAT #5
Flow (m3/day)	180092		1392		590				
Parameter	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)			
TSS (Note 1)	7.1	1271	* 4.9	6.9	2.9	1.8	See BAT #2.	See BAT #2.	Not applicable.
TSS (Note 2)	10	371							
oil and grease (Note 1)	1.6	294	6.2	8.7	7.1	3.8			
oil and grease (Note 2)	–	–							

Notes: 1. Data direct from MISA MIDES #0400, NORTH OUTFALL. The effluent from this outfall includes NCCW. The process water flowrate is about 37 070 m3/day.

2. No. 3 Bloom and Billet Mill data from Environment Canada Filter Study. Loadings were calculated from concentration and flow. Process Flow = 37 070 m3/day (Stelco estimate).

3. The current effluent from the North Outfall, MIDES #0400, passed the Ontario Toxicity Test ten out of ten times.

* less than RMDL

TABLE 13.5.2 STELCO HILTON WORKS

NO.3 BLOOM AND BILLET MILL APPL. BAT#1

FACILITIES	EST. CAP. COST $MM	EST. TYPE
• Cooling Tower	2.07	C
• Pumping station (inlet and outlet)	2.06	C
• Interconnecting Service:		
- Pipe from cooling tower to B&B mill	0.19	B
- Separation of N.C.C.W. from C.C.W	0.46	D
• Upgrading existing heat exchangers	0.30	D
• Thickener	1.32	C
• Thickener pumps	0.05	B
• Vacuum filter	0.52	C
TOTAL	**6.97**	

TABLE 13.5.3 : MISA MODEL / APPLIED BAT COSTING				
Mill :	Stelco Hilton Works			
Subcategory :	No. 3 Bloom and Billet Mill			
BAT :	Applied BAT #1			
Process Flow :	1397 m3/day			
Date:	92/02/19		Filename:	HILBB-CB.WK1
1. Capital Costs				
(a) Engineering and Design				$487,000
(b) Equipment				$1,626,000
(c) Installation				$1,731,000
(d) Facilities and Structure				$1,221,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$1,913,000
Total Capital Cost				$6,978,000
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements power	kWh	8356580	$0.05	$418,000
Total Energy Requirements				$418,000
(b) Materials				
chemicals				$200,000
Total Materials				$200,000
(c) Operating Labour				
(d) Maintenance	% of Capital	5.0%		$349,000
Total Operating & Maintenance				$967,000
4. Disposal of Sludges or Solid Wastes Increase over current operation.				
(a) Quantities Generated per Unit Time		1154	tonne/year	$231,000
(b) Disposal Cost per Unit		$200	$/tonne	

Comments:

Existing effluent data taken from MIDES #0400, North Outfall.

13.6 No. 2 Rod Mill

13.6.1 BAT #1 Best in Ontario

In order to achieve a BAT #1 level of effluent quality, sand filters and one cooling tower are required to recycle the Hot Forming wastewater from the lagoon back to the process. In addition, a backwash thickener and vacuum filter are required for the filter backwash. This modification is shown in Figure 13.6.1 *Stelco Hilton Works No. 2 Rod Mill Applied BAT #1 Best in Ontario*.

The predicted effluent quality data sheet Table 13.6.1, for the modified treatment system is attached. The capital and operating data for this treatment system are given in Tables 13.6.2. and 13.6.3.

13.6.2 BAT #2 Best in the United States

The BAT #2 modifications are the same as the BAT #1 modifications with the blowdown flow reduced to 0.36 m^3/tonne.

13.6.3 BAT #3 Best at Selected World Locations

The best available treatment technology for the Hot Forming wastewater was determined to be the BAT #2 process. The required modifications for applied BAT #2 are detailed in section 13.6.2.

13.6.4 BAT #4 Non-Lethal

The BAT #3 wastewater treatment technology for Hot Forming was determined to be the BAT #2 process. The applied BAT #2 modifications are outlined in section 13.6.2.

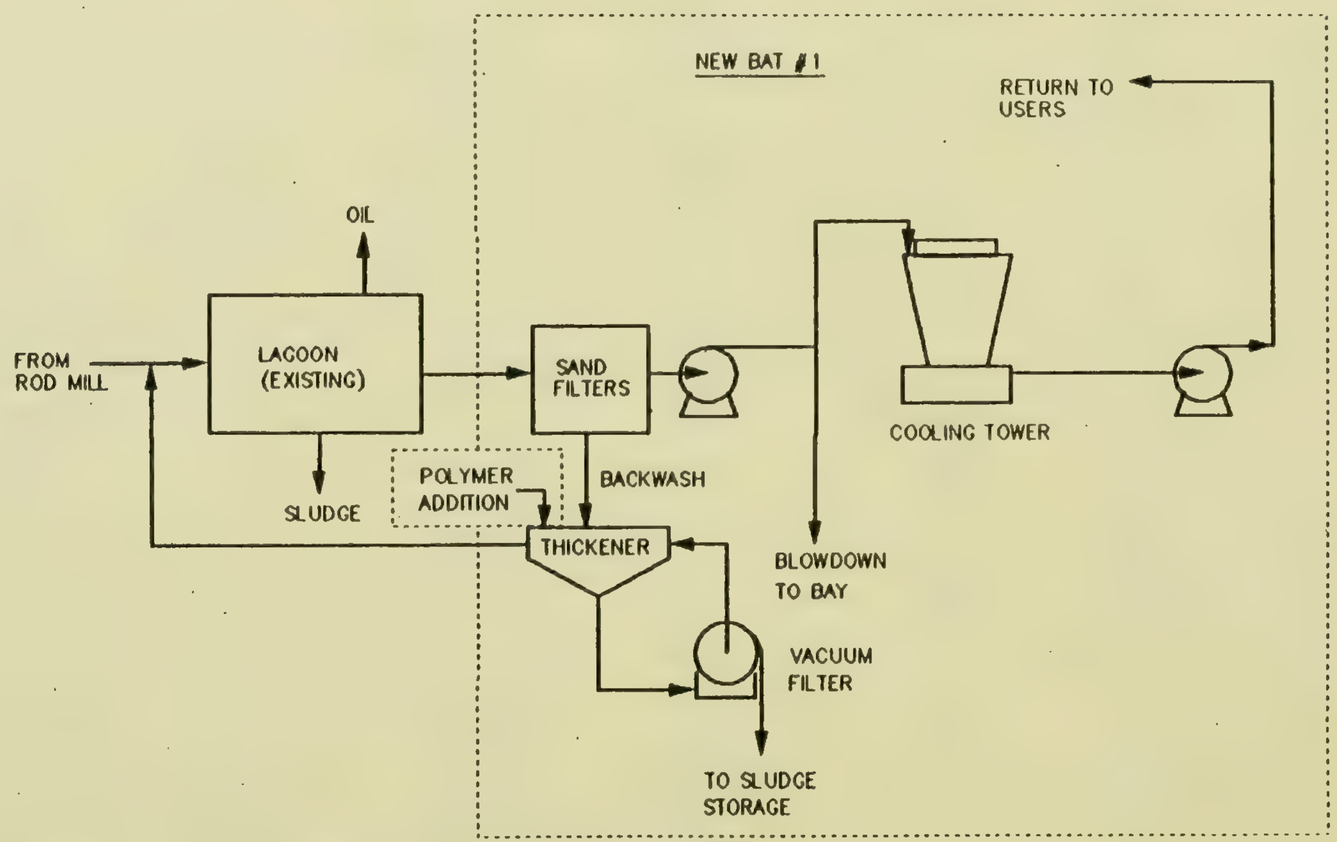
Based on toxicity testing during the MISA monitoring period, the BAT #3 Hot Forming effluent is likely to pass the Ontario Toxicity Test, depending on the level of dissolved solids in the effluent. However, toxicity testing on the blowdown stream is required to confirm this. This stream is discharged directly to the receiving water.

13.6.5 BAT #5 Virtual Elimination of Persistent Toxics

The BAT #3 wastewater treatment technology for Hot Forming was determined to be the BAT #2 process. The applied BAT #2 modifications are outlined in section 13.6.2.

Hot forming wastewater streams do not normally contain toxic metals or organics. Virtual elimination of persistent toxics is therefore not a requirement in this case and BAT #5 is not applicable.

STELCO HILTON WORKS - NO. 2 ROD MILL - APPLIED BAT #1 - BEST IN ONTARIO



PROCESS FLOW: 21.7 m3/tonne	BLOWDOWN FLOW : 0.85 m3/tonne	RECYCLE RATE: 96%		
STELCO HILTON WORKS			HATCH ASSOCIATES	1991-10-08	REV. 3

FIGURE 13.6.1

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – HOT FORMING – STELCO HILTON–No.2 ROD MILL

BAT	EXISTING (Note 1)		BAT #1		BAT #2		BAT #3	BAT #4	BAT #5
Flow (m3/day)	27058		1056		447				
Parameter	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)			
TSS	5.6	154	* 4.9	5.2	2.9	1.4	See BAT #2.	See BAT #2.	Not applicable.
oil and grease	1.4	37	6.3	6.6	7.1	2.9			

Notes: 1. Data direct from MISA MIDES #1100.

2. The current No.2 Rod Mill effluent, MIDES #1100, failed the Ontario Toxicity test four times out of nine tests for Daphnia Magna and passed nine times out of nine tests for Rainbow Trout.

* less than RMDL

1991-02-12	TABLE 13.6.1	HATCH ASSOCIATES	PEQHFROD.WK1 PEQHFROD.ALL	REV. # 4

TABLE 13.6.2 STELCO HILTON WORKS

NO.2 ROD MILL APPL. BAT#1

FACILITIES	EST. CAP. COST $MM	EST. TYPE
• Sand filter system including backwash tank and pumping station	13.38	A
• Filter backwash thickener including polymer addition station		
• Filter press		
• Interconnecting Services		
• Cooling tower	2.01	C
• Cooling Tower Pumping Station	1.38	B
TOTAL	**16.77**	

TABLE 13.6.3 : MISA MODEL / APPLIED BAT COSTING

Mill :	Stelco Hilton Works			
Subcategory :	No. 2 Rod Mill			
BAT :	Applied BAT #1			
Process Flow :	1057 m3/day (blowdown flow)			
Date:	92/02/19		Filename:	HILRM-CB.WK1

1. Capital Costs				
(a) Engineering and Design				$1,170,000
(b) Equipment				$3,656,000
(c) Installation				$3,949,000
(d) Facilities and Structure				$3,400,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$4,598,000
Total Capital Cost				$16,773,000
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements power	kWh	17644392	$0.05	$882,000
Total Energy Requirements				$882,000
(b) Materials				
chemicals				$100,000
Total Materials				$100,000
(c) Operating Labour	manyears	4	$60,000	$240,000
(d) Maintenance	% of Capital	5.0%		$839,000
Total Operating & Maintenance				$2,061,000
4. Disposal of Sludges or Solid Wastes Increase over current operation.				
(a) Quantities Generated per Unit Time		135.8	tonne/year	$27,000
(b) Disposal Cost per Unit		$200	$/tonne	

Comments:

13.7 Finishing

13.7.1 BAT #1 Best in Ontario

The finishing wastewater treatment system at Stelco Hilton Works is probably equivalent to or better than Dofasco's treatment system, but no MISA effluent data is available to allow a performance evaluation. No modifications to the treatment system are necessary for BAT #1. In order to permit recycle from the East Side Filtration Plant to the hot mills, however, the finishing wastewater stream must be redirected from the ESFP and treated separately. The cost to do this is the same as that for "Separation of Finishing Effluent" in Table 13.7.2.

13.7.2 BAT #2 Best in the United States

In order to achieve a BAT #2 level of effluent quality, a controlled metals precipitation step is required for the combined finishing wastewater streams prior to discharge to the receiving water. To allow the East Side Filtration plant to be dedicated to the Hot Forming recycle system, the finishing effluent is excluded and discharged separately after treatment in a reactor clarifier. The existing finishing flow of 6.55 m^3/tonne was used for costing purposes. The cost of a treatment plant capable of handling this flowrate was developed rather than costing a 6.1 m^3/tonne plant. This would require retrofit to the finishing operations to achieve the lower finishing flowrate. This modification is shown in Figure 13.7.1 *Stelco Hilton Works Finishing Applied BAT #2 Best in the United States*.

The predicted effluent quality data sheet, Table 13.7.1, for the modified treatment system is attached. The capital and operating data for this treatment system are given in Tables 13.7.2 and 13.7.3.

13.7.3 BAT #3 Best at Selected World Locations

The best available treatment technology for the finishing wastewater was determined to be the BAT #2 process. The required modifications for applied BAT #2 are detailed in section 13.7.2.

13.7.4 BAT #4 Non-Lethal

The BAT #3 wastewater treatment technology for Finishing was determined to be the BAT #2 process. The applied BAT #2 modifications are outlined in section 13.7.2.

There is no specific toxicity data available for the BAT #3 Finishing wastewater stream. However, the zinc, chromium and hexavalent chromium were determined to be below the single contaminant LC50 values. Therefore, the effluent may pass the Ontario Toxicity Test depending on synergistic effects and hardness. The synergistic effects of the several contaminants in the effluent are not known and cannot be predicted. No demonstrated technologies are known to further reduce the concentrations of metal toxics to lower levels than those measured in this wastewater. This effluent is discharged directly to the receiving water. An accurate assessment of the toxicity of this stream cannot be made at this time.

13.7.5 BAT #5 Virtual Elimination of Persistent Toxics

The BAT #3 wastewater treatment technology for Finishing was determined to be the BAT #2 process. The applied BAT #2 modifications are outlined in section 13.7.2.

The Finishing wastewater stream is expected to contain low levels of metal toxic contaminants. No demonstrated technologies are known to further reduce the concentrations of these compounds to lower levels those than measured in the wastewater stream. Virtual elimination of persistent toxics can only be assured by zero discharge. This may be achieved with further treatment by ultrafiltration and ion exchange, or evaporation which may permit the treated water to be recycled to the process. These treatment technologies are not demonstrated in this category for the purpose of achieving zero discharge, as defined in this report (ie. no aqueous point source discharge).

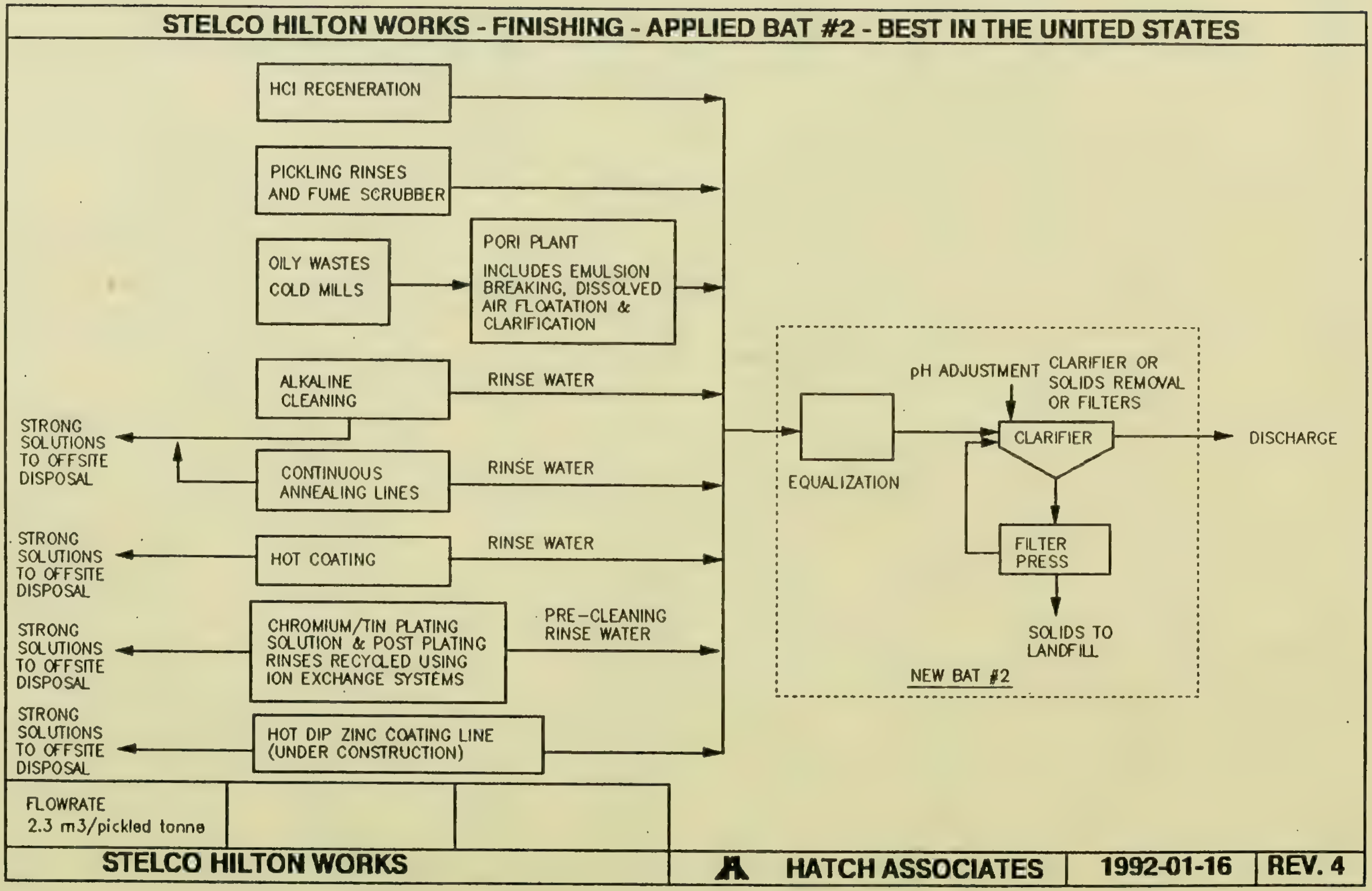

STELCO HILTON WORKS - FINISHING - APPLIED BAT #2 - BEST IN THE UNITED STATES
HCl REGENERATION
PICKLING RINSES AND FUME SCRUBBER
OILY WASTES COLD MILLS
PORI PLANT
INCLUDES EMULSION BREAKING, DISSOLVED AIR FLOATATION & CLARIFICATION
ALKALINE CLEANING
RINSE WATER
CONTINUOUS ANNEALING LINES
RINSE WATER
HOT COATING
RINSE WATER
CHROMIUM/TIN PLATING SOLUTION & POST PLATING RINSES RECYCLED USING ION EXCHANGE SYSTEMS
PRE-CLEANING RINSE WATER
HOT DIP ZINC COATING LINE (UNDER CONSTRUCTION)
STRONG SOLUTIONS TO OFFSITE DISPOSAL
STRONG SOLUTIONS TO OFFSITE DISPOSAL
STRONG SOLUTIONS TO OFFSITE DISPOSAL
STRONG SOLUTIONS TO OFFSITE DISPOSAL
EQUALIZATION
pH ADJUSTMENT
CLARIFIER OR SOLIDS REMOVAL OR FILTERS
CLARIFIER
DISCHARGE
FILTER PRESS
SOLIDS TO LANDFILL
NEW BAT #2
FLOWRATE
2.3 m3/pickled tonne
STELCO HILTON WORKS
HATCH ASSOCIATES
1992-01-16
REV. 4

FIGURE 13.7.1

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – FINISHING – STELCO HILTON (Note 1)

BAT	EXISTING	BAT #1	BAT #2 (Note 3)		BAT #3	BAT #4	BAT #5
Flow (m3/day)			21792				
Parameter			Average Conc. (mg/L)	Average Loading (kg/day)			
TSS			4.8	104			
oil and grease	No data	Note 2	2.3	50	See BAT #2.	See BAT #2.	No demonstrated
lead	available.		–	–			technology in
zinc	Flows combined		0.054	1.2			this industry
chromium	with other		0.051	1.1			sector.
hexavalent chromium	effluents.		0.011	0.24			

Notes:
1. The calculations were based on the Acid Pickling Production at Stelco Hilton Works.
2. Stelco Hilton Works finishing treatment train with its final effluent filtration in the East Side Filtration Plant is probably equivalent to or better than Dofasco's treatment system. No effluent data is available to allow a proper evaluation.
3. The BAT #2 flow is based on the Model BAT #2 flow of 6.1 m3/tonne. The actual Finishing flow at Stelco Hilton of 6.5 m3/tonne was used for costing purposes. A cost based on 6.1 m3/tonne would be equal in magnitude to the cost based on 6.5 m3/tonne.

TABLE 13.7.2 STELCO HILTON WORKS

FINISHING APPL. BAT#2

FACILITIES	EST. CAP. COST $MM	EST. TYPE
Finishing Treatment Plant		
• Lime storage and feed system	2.04	C
• Reactor tanks including agitators	2.13	C
• Reactor Clarifier including pumps and polymer adding station (2)	9.05	C
• Filter press including feed pumps	4.32	C
• Overflow pumps c/w sump tank	0.55	C
• Wastewater sump + pumps(acid resistant)	1.06	B
Separation of Finishing Effluent		
• Piping modifications	0.30	D
• Separation of finishing wastewater from hot forming wastewater	3.41	B
• Pumping stations at main effluent discharge points	3.21	B
• Non-contact cooling water separation - piping	0.51	B
TOTAL	**26.58**	

TABLE 13.7.3 : MISA MODEL / APPLIED BAT COSTING				
Mill : Stelco Hilton Works Subcategory : Finishing BAT : Applied BAT #2 Process Flow : 32025 m3/day Date: 92/02/19			Filename: HILFI-CB.WK1	
1. Capital Costs				
(a) Engineering and Design				$1,854,000
(b) Equipment				$6,261,000
(c) Installation				$6,650,000
(d) Facilities and Structure				$4,531,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$7,287,000
Total Capital Cost				**$26,583,000**
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements power	kWh	12073338	$0.05	$604,000
Total Energy Requirements				$604,000
(b) Materials				
LIME	kg	4000000	$0.250	$1,000,000
POLYMER				$500,000
Total Materials				$1,500,000
(c) Operating Labour	manyears	4	$60,000	$240,000
(d) Maintenance	% of Capital	5.0%		$1,329,000
Total Operating & Maintenance				$3,673,000
4. Disposal of Sludges or Solid Wastes		No data available.		
(a) Quantities Generated per Unit Time			tonne/year	183
(b) Disposal Cost per Unit		$200.00	$/tonne	$37,000

Comments:

No data available on Existing effluent. Flows combined with other effluents.

13.8 Integrated Mills Including Finishing

13.8.1 BAT #1 Best in Ontario

Currently at Stelco Hilton Works, there is very little recirculation of process water within the facility. It is proposed to install recycle systems for all process areas except for the cokemaking byproducts area and the finishing area. The additional wastewater treatment required for each system is detailed in the above sections. A combined Blowdown Treatment Plant is proposed for the Cokemaking, Ironmaking and Sintering wastewaters. The treatment process will consist of equalization, metals removal, chlorination and filtration prior to discharge. The finishing wastewater is treated in a separate treatment facility prior to discharge.

The water from the hot forming mills is filtered at the East Side Filtration Plant then cooled and recycled to the processes. A separate recirculation system is installed on the Continuous Caster, the No. 3 Bloom and Billet Mill and the No. 2 Rod Mill. These modifications are shown in Figure 13.8.1 *Stelco Hilton Works Integrated Mills Including Finishing Applied BAT #1 Best in Ontario*.

The predicted effluent quality data sheet, Table 13.8.1, for these modifications is attached. As discussed in Section 7.1, this table is presented for information purposes only. The table summarizes the effluent data for each BAT option. BAT #1 is based on data for Stelco LEW's final effluent and data for Dofasco's Finishing effluent. BAT #2A is based on National Steel, Granite City which is an integrated mill with central treatment facilities and finishing operations. BAT #2B represents the sum of the BAT #2 options for all categories. Model BAT #3 is based on data for Stelco LEW's final effluent and data for National Steel Midwest for finishing effluent.

13.8.2 BAT #2 Best in the United States

The overall wastewater treatment processes and recirculation systems for BAT #2 are similar to the BAT #1 modifications detailed in section 13.8.1.

13.8.3 BAT #3 Best at Selected World Locations

The best available integrated wastewater treatment facility was determined to be the BAT #1 facility. The applied BAT #1 modification are described in section 13.8.1.

13.8.4 BAT #4 Non-Lethal

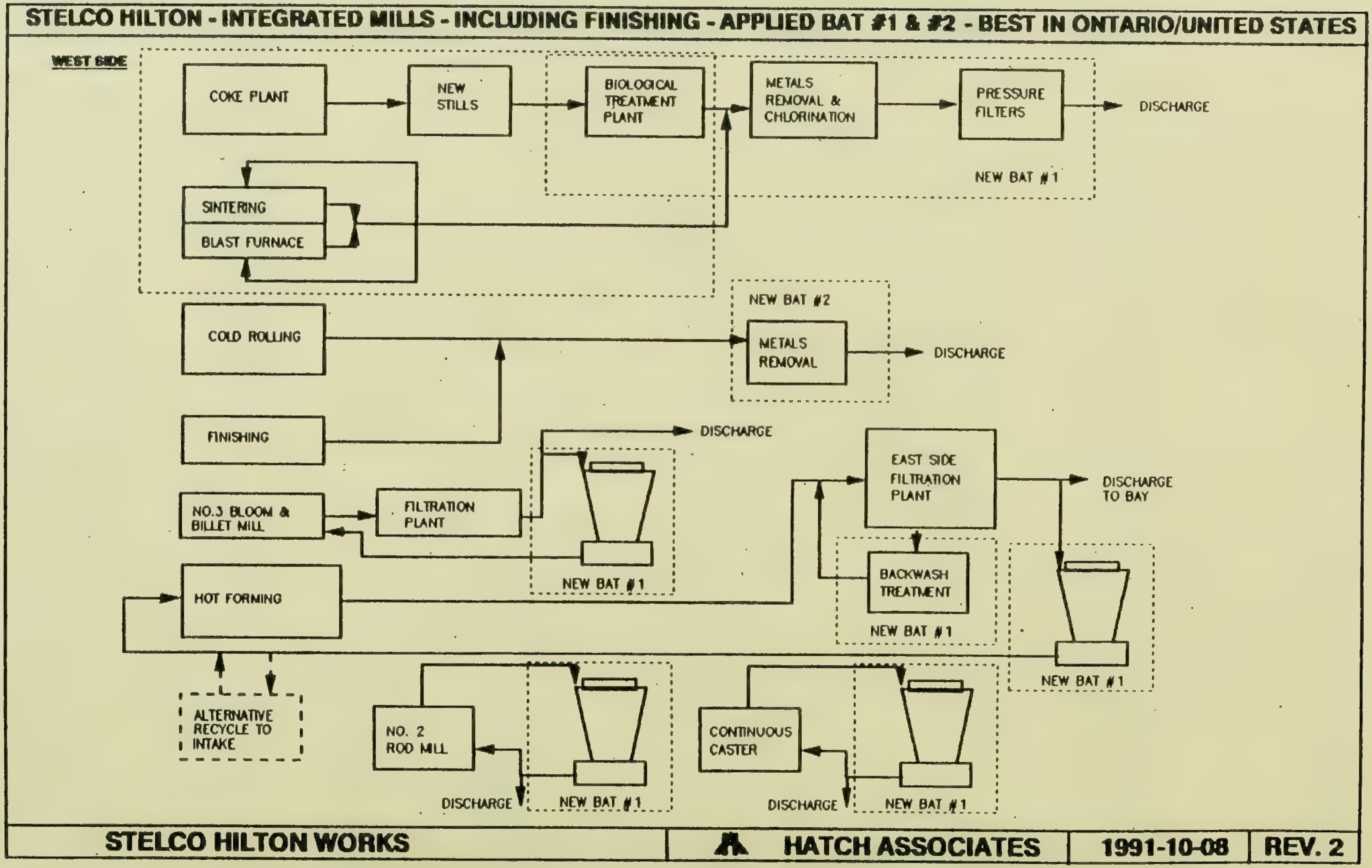
The BAT #3 wastewater treatment technology for Integrated Mills Including Finishing was determined to be the BAT #1 process. The applied BAT #1 modifications are outlined in section 13.8.1

The treated wastewater streams from the various process areas are not combined in a centralized treatment plant prior to discharge, as is practised at Stelco LEW. Therefore, the Stelco LEW toxicity data cannot be used to assess the toxicity of the discharges from Stelco Hilton. Assessments of the toxicity of the wastewater streams discharged from this facility are described in the previous sections.

13.8.5 BAT #5 Virtual Elimination of Persistent Toxics

The BAT #3 wastewater treatment technology for Integrated Mills Including Finishing was determined to be the BAT #1 process. The applied BAT #1 modifications are outlined in section 13.8.1.

Assessments of each of the effluent streams for persistent toxic contaminants are described in the previous sections.



STELCO HILTON - INTEGRATED MILLS - INCLUDING FINISHING - APPLIED BAT #1 & #2 - BEST IN ONTARIO/UNITED STATES
WEST SIDE
COKE PLANT
NEW STILLS
BIOLOGICAL TREATMENT PLANT
METALS REMOVAL & CHLORINATION
PRESSURE FILTERS
DISCHARGE
NEW BAT #1
SINTERING
BLAST FURNACE
NEW BAT #2
COLD ROLLING
METALS REMOVAL
DISCHARGE
FINISHING
DISCHARGE
EAST SIDE FILTRATION PLANT
DISCHARGE TO BAY
NO.3 BLOOM & BILLET MILL
FILTRATION PLANT
NEW BAT #1
BACKWASH TREATMENT
HOT FORMING
NEW BAT #1
NEW BAT #1
ALTERNATIVE RECYCLE TO INTAKE
NO. 2 ROD MILL
CONTINUOUS CASTER
DISCHARGE
NEW BAT #1
DISCHARGE
NEW BAT #1
STELCO HILTON WORKS
HATCH ASSOCIATES
1991-10-08
REV. 2

FIGURE 13.8.1

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – INCLUDING FINISHING – STELCO HILTON

BAT	EXISTING (Note 1)		BAT #1 (Note 2)		BAT #2 – A (Note 3)		BAT #2 – B (Note 2)		BAT #3 (Note 2)		BAT #4	BAT #5
Flow (m3/day)	835715		32326		60418		27290		50189			
Parameter	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)		
TSS	7.2	6019	63	2032	5.4	326	7.6	206	4.8	243		
oil and grease	1.9	1569	9.5	307	4.9	296	2.4	66	1.8	89	See	Note 4
ammonia + ammonium	0.7	623	* 0.073	2.4	0.59	36	3.5	97	0.047	2.4	BAT #3.	
cyanide total	0.041	35	0.10	3.2	0.0034	0.21	0.33	9.1	0.064	3.2		
phenolics (4AAP)	0.014	11	0.0021	0.066	0.0029	0.18	0.0066	0.18	0.0013	0.066		
lead	* 0.0078	6.5	0.039	1.2	0.0047	0.28	0.0031	0.085	0.018	0.91		
zinc	0.055	46	0.075	2.4	0.045	2.7	0.056	1.5	0.060	3.0		
benzene	0.0024	2.0	* 0.00022	0.0073	-	-	0.00013	0.0036	0.00014	0.0073		
benzo(a)pyrene	* 0.00052	0.44	* 0.00045	0.015	-	-	0.0010	0.027	0.00029	0.015		
naphthalene	* 0.00031	0.26	* 0.00026	0.0085	-	-	0.00051	0.014	0.00017	0.0085		
chromium	* 0.010	8.7	0.11	3.4	-	-	0.041	1.1	0.027	1.4		
hexavalent chromium	* 0.0065	5.4	-	-	-	-	0.0086	0.24	0.0047	0.24		

Notes:
1. The sum of all wastewater discharges from Hilton except the Ammonia Still effluent (MISA Monitoring Points 0100, 0200, 0400 and 0601). The Ammonia Still effluent discharges to the City Sewer and was not monitored during the MISA Monitoring Period.
2. Loading (kg/day) = Loading Excluding Finishing (g/tonne) times Steelmaking Production (tonne/day) + Loading Finishing (g/tonne) x Acid Pickling production (tonne/day).
3. Calculations based on Stelco Hilton's Steelmaking production only (Stelco Hilton's acid pickling prod'n approx 20% > National, Granite BAT #2A)
4. No demonstrated technology in this industry sector.

* less than RMDL

1992-02-13	TABLE 13.8.1	HATCH ASSOCIATES	PEQCTHIL.WK1 PEQCTHIL.ALL	REV. # 3

14.0 APPLIED BAT STELCO STEEL, LAKE ERIE WORKS

14.1 Cokemaking

Stelco's Lake Erie Works facility in Nanticoke, Ontario was determined to be the best available cokemaking wastewater treatment system of all the facilities surveyed for this study. The treatment process the facility is described in section 5.2.1. No modifications to the wastewater treatment system are required to achieve BAT #2, BAT #3 and BAT #4.

The predicted effluent quality data sheet is given in Table 14.1.1.

As discussed in Section 13.1.5, treatment technologies to achieve virtual elimination are not demonstrated in this application.

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – COKEMAKING – STELCO LEW

BAT	EXISTING (Note 1)		BAT #1	BAT #2	BAT #3	BAT #4	BAT #5
Flow (m3/day)	961						
Parameter	Average Conc. (mg/L)	Average Loading (kg/day)					
TSS	7.3	7.0	See existing.	See existing.	See existing.	See existing.	No demonstrated technology in this industry sector.
oil and grease	1.4	1.4					
ammonia + ammonium	* 0.17	0.17					
cyanide total	0.93	0.89					
phenolics (4AAP)	0.012	0.012					
benzene	0.0052	0.0050					
benzo(a)pyrene	0.010	0.010					
naphthalene	0.0062	0.0060					

Notes: 1. Data calculated by disaggregation of loadings from MISA Monitoring Point 0400, based on Stelco LEW information.

* less than RMDL

1991-10-07	TABLE 14.1.1	HATCH ASSOCIATES	PEQCMLEW.WK1 PEQCMLEW.ALL	REV. # 3

14.2 Ironmaking

14.2.1 BAT #1 Best in Ontario

Stelco's Lake Erie Works facility was determined to be the best available ironmaking wastewater treatment system in Ontario, therefore, there are no modifications required to achieve BAT #1 effluent quality.

14.2.2 BAT #2 Best in the United States

The BAT #2 blowdown flow achieved at Bethlehem Steel's Sparrows Point facility is 0.26 m^3/tonne. Further flow reduction at Stelco Lake Erie Works might be achievable. At Inland Steel, Indiana Harbor Works zero discharge is achieved by evaporating the system blowdown on the slag.

Stelco advises that it would be necessary to prevent the cascade of NCCW from entering the scrubber water system, at a capital cost in the order of $500,000.

The predicted effluent quality data sheet, Table 14.2.1, for this modification is attached.

14.2.3 BAT #3 Best at Selected World Locations

The best available treatment technology was determined to be the BAT #1 process or BAT #2 with evaporation of the system blowdown on the slag. The required modifications for applied BAT #2 are detailed in section 14.2.2.

14.2.4 BAT #4 Non-Lethal

The BAT #3 wastewater treatment technology for Ironmaking was determined to be the BAT #1 process. The applied BAT #1 modifications are outlined in section 14.2.1.

There is no specific toxicity data available for the BAT #3 Ironmaking wastewater stream. This stream is not discharged directly to the receiving water, but is co-treated with other streams at the Blowdown Treatment Plant prior to discharge. The current final effluent passes the Ontario Toxicity Test most of the time.

14.2.5 BAT #5 Virtual Elimination of Persistent Toxics

The BAT #3 wastewater treatment technology for Ironmaking was determined to be the BAT #1 process. The applied BAT #1 modifications are outlined in section 14.2.1.

This wastewater stream is expected to contain very low levels (in some cases below the RMDL) of organic compounds. No demonstrated technologies are known to further reduce the concentrations of these compounds to lower levels. However, this stream is not discharged directly to the receiving water. The stream is co-treated with other streams in the Blowdown Treatment Plant prior to discharge. As discussed in Volume I, virtual elimination of persistent toxics may have been achieved at Stelco LEW, MISA point 400.

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – IRON MAKING – STELCO LEW

BAT	EXISTING (Note 1)		BAT #1	BAT #2A		BAT #2B	BAT #3	BAT #4	BAT #5
Flow (m3/day)	2863			935					
Parameter	Average Conc. (mg/L)	Average Loading (kg/day)		Average Conc. (mg/L)	Average Loading (kg/day)				
TSS	* 4.9	14	See existing.	8.6	7.9	No effluent to receiving water – slag evaporation.	See BAT #1.	See BAT #1.	No demonstrated technology in this industry sector.
oil and grease	–	–		–	–				
ammonia + ammonium	0.52	1.5		62	58				
cyanide total	0.47	1.3		0.14	0.13				
phenolics (4AAP)	0.012	0.035		0.083	0.079				
lead	* 0.022	0.063		0.019	0.018				
zinc	0.045	0.13		0.20	0.19				

Notes: 1. Data calculated by disaggregation of loadings from MIDES #0400, based on Stelco LEW information.

* less than RMDL

1992-02-12	TABLE 14.2.1	HATCH ASSOCIATES	PEQIRLEW.WK1 PEQIRLEW.ALL	REV. #4

14.3 BOF Steelmaking

14.3.1 BAT #1 Best in Ontario

Stelco's Lake Erie Works facility was determined to be the best available Steelmaking wastewater treatment system in Ontario, therefore, there are no modifications required to achieve BAT #1 effluent quality.

14.3.2 BAT #2 Best in the United States

The BAT #2 blowdown flow achieved at LTV Steel in Cleveland, Ohio is 0.002 m^3/tonne. This flow is achieved with the use of a CO_2 softening system. Further flow reduction at Stelco Lake Erie Works may be achievable with the installation of a CO_2 softening system to precipitate the carbonates prior to the BOF thickener. To achieve the desired CO_3 - alkalinity levels of softening, raw water make ups must be rerouted to thickener influent and controlled from there. It is critical to have control over the system make-ups and blowdowns to ensure the available carbonate alkalinity is kept in the system. This treatment system is shown in Figure 14.3.1 *Stelco Lake Erie Works Steelmaking Applied BAT #2 Best in the United States*.

Due to the interdependency of the water system at Stelco LEW, a thickener is required for the Hot Strip Mill blowdown stream. The thickener overflow could be directed to the dirty water sump and the underflow could be directed to the OG system. In addition, approximately 2448 m^3/day of make up should be diverted to the RHOB. The clean blowdown from the RHOB should be directed to the dirty water sump. Selected water flows can be filtered and recycled for use as pump seal water.

The predicted effluent quality data sheet, Table 14.3.1, for the modified treatment system is attached. The capital and operating cost data for this modification are given in Tables 14.3.2 and 14.3.3.

14.3.3 BAT #3 Best at Selected World Locations

The best available treatment technology was determined to be the BAT #2 process. The required modifications for applied BAT #2 are detailed in section 14.3.2.

14.3.4 BAT #4 Non-Lethal

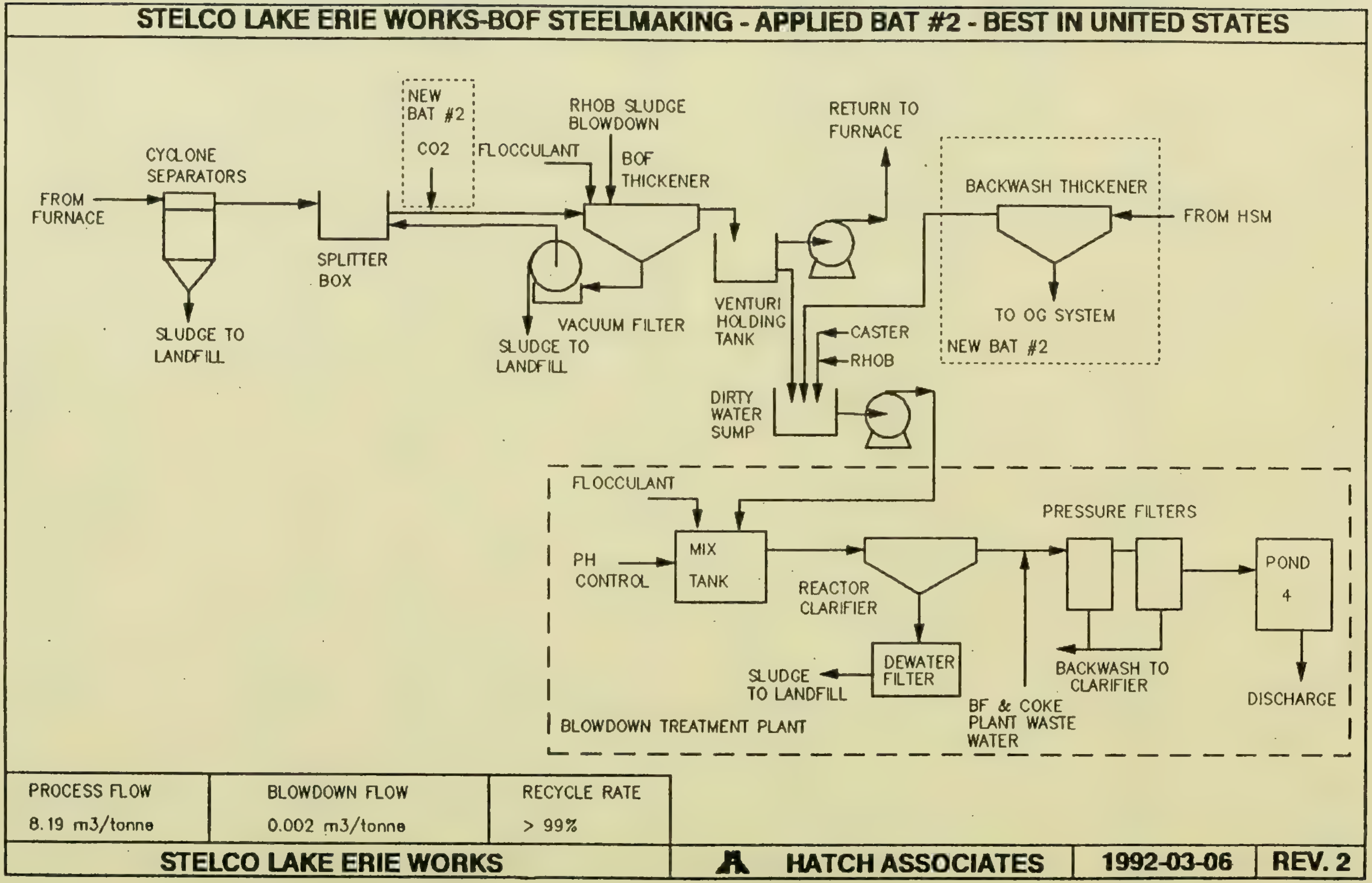
The BAT #3 wastewater treatment technology for Steelmaking was determined to be the BAT #2 process. The applied BAT #2 modifications are outlined in section 14.3.2.

There is no specific toxicity data available for the BAT #3 Steelmaking wastewater stream. However, based on an assessment of the effluent characteristics, specifically the single contaminant LC50 values, the effluent is likely to pass the Ontario Toxicity Test depending on hardness. No demonstrated technologies are known to further reduce the zinc concentration to a lower level than measured in the wastewater stream. However, this stream is not discharged directly to the receiving water. The effluent is co-treated with other wastewater streams in the Blowdown Treatment Plant prior to discharge. The current final effluent at Stelco LEW passes the Ontario Toxicity Test most of the time.

14.3.5 BAT #5 Virtual Elimination of Persistent Toxics

The BAT #3 wastewater treatment technology for Steelmaking was determined to be the BAT #2 process. The applied BAT #2 modifications are outlined in section 14.3.2.

The BAT #3 Steelmaking wastewater stream is not expected to contain any persistent bioaccumulative toxics, however, the stream is expected to contain low levels of lead and zinc. No demonstrated technologies are known to further reduce the concentrations of these compounds. However, this stream is not discharged directly to the receiving water. The stream is co-treated with other wastewater streams in the Blowdown Treatment plant prior to discharge. As discussed in Volume I, virtual elimination of persistent toxics may have been achieved at Stelco LEW, MISA point 400.



STELCO LAKE ERIE WORKS-BOF STEELMAKING - APPLIED BAT #2 - BEST IN UNITED STATES
FROM FURNACE
CYCLONE SEPARATORS
SLUDGE TO LANDFILL
SPLITTER BOX
NEW BAT #2
CO2
FLOCCULANT
RHOB SLUDGE BLOWDOWN
BOF THICKENER
VACUUM FILTER
SLUDGE TO LANDFILL
VENTURI HOLDING TANK
RETURN TO FURNACE
CASTER
RHOB
DIRTY WATER SUMP
BACKWASH THICKENER
FROM HSM
TO OG SYSTEM
NEW BAT #2
FLOCCULANT
PH CONTROL
MIX TANK
REACTOR CLARIFIER
DEWATER FILTER
SLUDGE TO LANDFILL
BF & COKE PLANT WASTE WATER
PRESSURE FILTERS
BACKWASH TO CLARIFIER
POND 4
DISCHARGE
BLOWDOWN TREATMENT PLANT
PROCESS FLOW
8.19 m3/tonne
BLOWDOWN FLOW
0.002 m3/tonne
RECYCLE RATE
> 99%
STELCO LAKE ERIE WORKS
HATCH ASSOCIATES
1992-03-06
REV. 2

FIGURE 14.3.1

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – STEELMAKING – STELCO LEW (Note 1)

BAT	EXISTING (Note 2)		BAT #1A	BAT #2A		BAT #3A	BAT #3B	BAT #4	BAT #5
Flow (m3/day)	4652			8.4					
Parameter	Average Conc. (mg/L)	Average Loading (kg/day)		Average Conc. (mg/L)	Average Loading (kg/day)				
TSS	* 4.9	23	See existing.	4.2	0.035	Wet Gas Cleaning, see BAT #2A.	Dry Gas Cleaning, no effluent.	See BAT #3A or BAT #3B.	Note 3
oil and grease	-	-		-	-				
lead	0.093	0.44		0.029	0.00024				
zinc	0.19	0.89		0.18	0.0015				

Notes: 1. Stelco LEW has a suppressed combustion BOF Shop with wet gas cleaning.

2. Data calculated by disaggregation of loadings from MISA Monitoring Point 0400, based on Stelco LEW information.

3. Wet Gas Cleaning: No demonstrated technology in this industry sector; or Dry Gas Cleaning.

* less than RMDL

1991-10-08	TABLE 14.3.1	HATCH ASSOCIATES	PEQSMLEW.WK1 PEQSMLEW.ALL	REV. # 3

TABLE 14.3.2 : STELCO LAKE ERIE WORKS
STEELMAKING - APPLIED BAT 2 COSTING

FACILITY DESCRIPTION	EST.CAP.COST $MM	ESTIMATE TYPE
CO_2 Feed System	0.14	C
Thickener for HSM Blowdown	1.32	C
Piping From Quencher Pump Room To RHOB	0.072	B
Sand Filters For Pump Seal Water	0.53	C
Piping From Filter Backwash To OG System	0.03	B
TOTAL	2.09	

TABLE 14.3.3 : MISA MODEL / APPLIED BAT COSTING				
Mill :	Stelco Steel, Lake Erie Works			
Subcategory :	Steelmaking			
BAT :	2 – CO2 Softening system + rerouting of HSM flows			
Process Flow :	8.3 M3/HR (steelmaking), 110 M3/HR (HSM), 36 M3/HR (pump seals)			
Date:	92/03/10		Filename:	LEWSMCB2.WK1
1. Capital Costs				
(a) Engineering and Design				$146,000
(b) Equipment				$466,000
(c) Installation				$500,000
(d) Facilities and Structure				$402,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$572,000
Total Capital Cost				**$2,086,000**
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements	kWh	320000	$0.05	$16,000
Total Energy Requirements				$16,000
(b) Materials				
Liquid CO2 usage	Tonnes	390	$120	$47,000
Tank & evaporator lease	$/month	12	$450	$5,000
Polymer				$250,000
Total Materials				$302,000
(c) Operating Labour	Man years	1	$60,000	$60,000
(d) Maintenance	% of Capital	5.00%		$104,000
Total Operating and Maintenance				$482,000
4. Disposal of Sludges or Solid Wastes				
(a) Quantities Generated per Unit Time		No increase		
(b) Disposal Cost per Unit				

Comments:
Liquid CO2 will be supplied by Liquid Carbonic. Liquid CO2 tank and evaporator will be leased from Liquid Carbonic.
Contribution to central evaporation system is so small it can be ignored.

14.4 Continuous Casting

14.4.1 BAT #1 Best in Ontario

Stelco's Lake Erie Works facility was determined to be the best available Continuous Casting wastewater treatment system in Ontario, therefore, there are no modifications required to achieve BAT #1 effluent quality.

14.4.2 BAT #2 Best in the United States

The BAT #2 blowdown flow achieved at Inland Steel's Indiana Harbor Works facility is 0.076 m^3/tonne. Further flow reduction at Stelco Lake Erie Works may be achievable. In order to achieve these blowdown reductions a backwash thickener is required for the backwash from the sand filters. The thickener overflow should be directed to the scale pit and the underflow directed to the dirty water sump. In addition, strainer backwashes should be recycled and the stormwater sumps should be rerouted to achieve the BAT #2 blowdown rate. These treatment system is shown in Figure 14.4.1. *Stelco Lake Erie Works Continuous Casting Applied BAT #2 Best in the United Stated.*

The predicted effluent quality data sheet, Table 14.4.1, for these modifications is attached. The capital and operating cost data for this treatment system are given in Tables 14.4.2 and 14.3.3.

14.4.3 BAT #3 Best at Selected World Locations

The best available treatment technology was determined to be the BAT #2 process. The required modifications for applied BAT #2 are detailed in section 14.4.2.

14.4.4 BAT #4 Non-Lethal

The BAT #3 wastewater treatment technology for Continuous Casting was determined to be the BAT #2 process. The applied BAT #2 modifications are outlined in section 14.4.2.

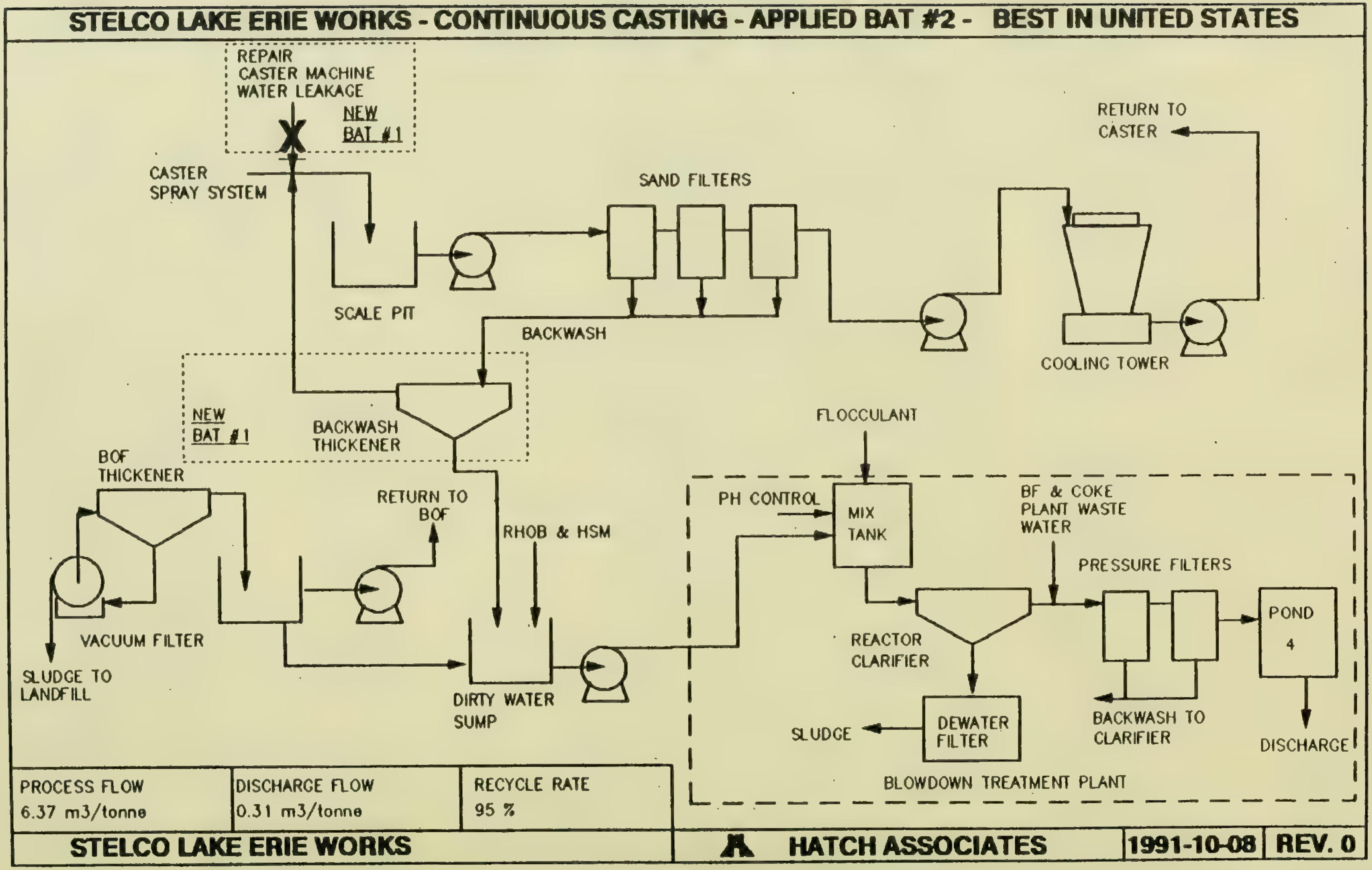
There is no specific toxicity data available for the Continuous Casting wastewater stream. However, based on an assessment of the effluent characteristics, specifically the single contaminant LC50 values, the effluent may pass the Ontario Toxicity Test depending on hardness and dissolved solids. No demonstrated technologies are known to further reduce the

zinc concentration to a lower level than measured in the wastewater stream. However, this stream is not discharged directly to the receiving water, but is co-treated with other streams in the Blowdown Treatment Plant prior to discharge. The current final effluent at Stelco LEW passes the Ontario Toxicity Test most of the time.

14.4.5 BAT #5 Virtual Elimination of Persistent Toxics

The BAT #3 wastewater treatment technology for Continuous Casting was determined to be the BAT #2 process. The applied BAT #2 modifications are outlined in section 14.4.2.

The Continuous Casting wastewater stream is not expected to contain any persistent bioaccumulative toxics, however, the stream is expected to contain low levels of lead and zinc. No demonstrated technologies are known to further reduce the concentrations of these compounds. However, this stream is not discharged directly to the receiving water. The stream is co-treated with other streams in the Blowdown Treatment Plant prior to discharge. As discussed in Volume I, virtual elimination of persistent toxics may have been achieved at Stelco LEW, MISA point 400.



STELCO LAKE ERIE WORKS - CONTINUOUS CASTING - APPLIED BAT #2 - BEST IN UNITED STATES
REPAIR
CASTER MACHINE
WATER LEAKAGE
NEW
BAT #1
CASTER
SPRAY SYSTEM
SCALE PIT
SAND FILTERS
BACKWASH
RETURN TO
CASTER
COOLING TOWER
NEW
BAT #1
BACKWASH
THICKENER
BOF
THICKENER
VACUUM FILTER
SLUDGE TO
LANDFILL
RETURN TO
BOF
RHOB & HSM
DIRTY WATER
SUMP
FLOCCULANT
PH CONTROL
MIX
TANK
BF & COKE
PLANT WASTE
WATER
PRESSURE FILTERS
POND
4
REACTOR
CLARIFIER
DEWATER
FILTER
SLUDGE
BACKWASH TO
CLARIFIER
DISCHARGE
BLOWDOWN TREATMENT PLANT
PROCESS FLOW
6.37 m3/tonne
DISCHARGE FLOW
0.31 m3/tonne
RECYCLE RATE
95 %
STELCO LAKE ERIE WORKS
HATCH ASSOCIATES
1991-10-08
REV. 0

FIGURE 14.4.1

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – CONTINUOUS CASTING – STELCO LEW

BAT	EXISTING (Note 1)		BAT #1	BAT #2		BAT #3	BAT #4	BAT #5
Flow (m3/day)	5745			320				
Parameter	Average Conc.	Average Loading		Average Conc.	Average Loading			
	(mg/L)	(kg/day)		(mg/L)	(kg/day)			
TSS	* 4.9	28	See existing.	21	5.9	See BAT #2.	See BAT #2.	No demonstrated technology in this industry sector.
oil and grease	1.4	8.3		1.8	0.67			
lead	–	–		0.13	0.037			
zinc	–	–		0.11	0.034			

Notes: 1. Data calculated by disaggregation of loadings from MISA Monitoring Point 0400, based on Stelco LEW information.

* less than RMDL

1991-10-08	TABLE 14.4.1	HATCH ASSOCIATES	PEQCCLEW.WK1 PEQCCLEW.ALL	REV. # 3

TABLE 14.4.2 : STELCO LAKE ERIE WORKS
CONTINUOUS CASTING - APPLIED BAT 2 COSTING

FACILITY DESCRIPTION		EST.CAP.COST $MM	ESTIMATE TYPE
Thickener For Filter Backwash		1.52	C
Piping From Thickener To Scale-Pit		0.096	B
Backwash Tank + Agitators + Pumps		0.99	C
Tank + Piping for Strainer Backwash		0.023	C
	TOTAL	2.63	

TABLE 14.4.3 : MISA MODEL / APPLIED BAT COSTING				
Mill :	Stelco Steel, Lake Erie Works			
Subcategory :	Continuous Casting			
BAT :	2 – Filter Backwash Thickener + Tank + piping			
Process Flow :	144 M3/HR			
Date:	92/03/10		Filename:	LEWCCB2.WK1
1. Capital Costs				
(a) Engineering and Design				$183,000
(b) Equipment				$586,000
(c) Installation				$629,000
(d) Facilities and Structure				$509,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$720,000
Total Capital Cost				$2,627,000
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements	kWh	549000	$0.05	$27,000
Total Energy Requirements				$27,000
(b) Materials				
chemicals				$250,000
				$0
Total Materials				$250,000
(c) Operating Labour	Man years	1	$60,000	$60,000
(d) Maintenance	% of Capital	5.00%		$131,000
Total Operating and Maintenance				$468,000
4. Disposal of Sludges or Solid Wastes				
(a) Quantities Generated per Unit Time		No increase		
(b) Disposal Cost per Unit				
Comments:				

14.5 Hot Forming

14.5.1 BAT #1 Best in Ontario

Stelco's Lake Erie Works facility was determined to be the best available Hot Forming wastewater treatment system in Ontario, therefore, there are no modifications required to achieve BAT #1 effluent quality.

14.5.2 BAT #2 Best in the United States

The BAT #2 blowdown flow achieved at US Steel's Gary Works facility is 0.36 m^3/tonne. Further flow reduction at Stelco Lake Erie Works may be achievable, but difficulty may be experienced in maintaining water chemistry with this lower flow. In order to achieve the blowdown reductions for the steelmaking wastewater system a backwash thickener is required for the backwash from the sand filters at the Hot Strip Mill. The overflow from the thickeners directed to the dirty water sump and the underflow is directed to the OG system. This treatment system is shown in Figure 14.5.1 *Stelco, Lake Erie Works Hot Forming Applied BAT #2 Best in the United States*. There is likely a need to separate and collect run-off and groundwater in order to achieve the indicated flows.

The predicted effluent quality data sheet, Table 14.5.1, for these modifications is attached. The capital and operating cost data for this treatment system are given in Tables 14.5.2 and 14.5.3.

14.5.3 BAT #3 Best at Selected World Locations

The best available treatment technology was determined to be the BAT #2 process. The required modifications for applied BAT #2 are detailed in section 14.5.2.

14.5.4 BAT #4 Non-Lethal

The BAT #3 wastewater treatment technology for Hot Forming was determined to be the BAT #2 process. The applied BAT #2 modifications are outlined in section 14.5.2.

There is no specific toxicity data available for the BAT #3 Hot Forming wastewater stream. However, based on toxicity testing during the MISA monitoring period at Algoma (No. 2 Tube Mill), Dofasco (No. 2 Hot Mill), Stelco (No. 3 Bloom & Billet Mill) and USEPA toxicity testing of

similar streams, the effluent is considered very likely to pass the Ontario Toxicity Test. This stream is not discharged directly to the receiving water, but is co-treated with other streams at the Blowdown Treatment Plant prior to discharge. The current final effluent at Stelco LEW passes the Ontario Toxicity Test most of the time.

14.5.5 BAT #5 Virtual Elimination of Persistent Toxics

The BAT #3 wastewater treatment technology for Hot Forming was determined to be the BAT #2 process. The applied BAT #2 modifications are outlined in section 14.5.2.

Hot forming wastewater streams do not normally contain toxic metals or organics. Virtual elimination of persistent toxics is therefore not a requirement in this case and BAT #5 is not applicable.

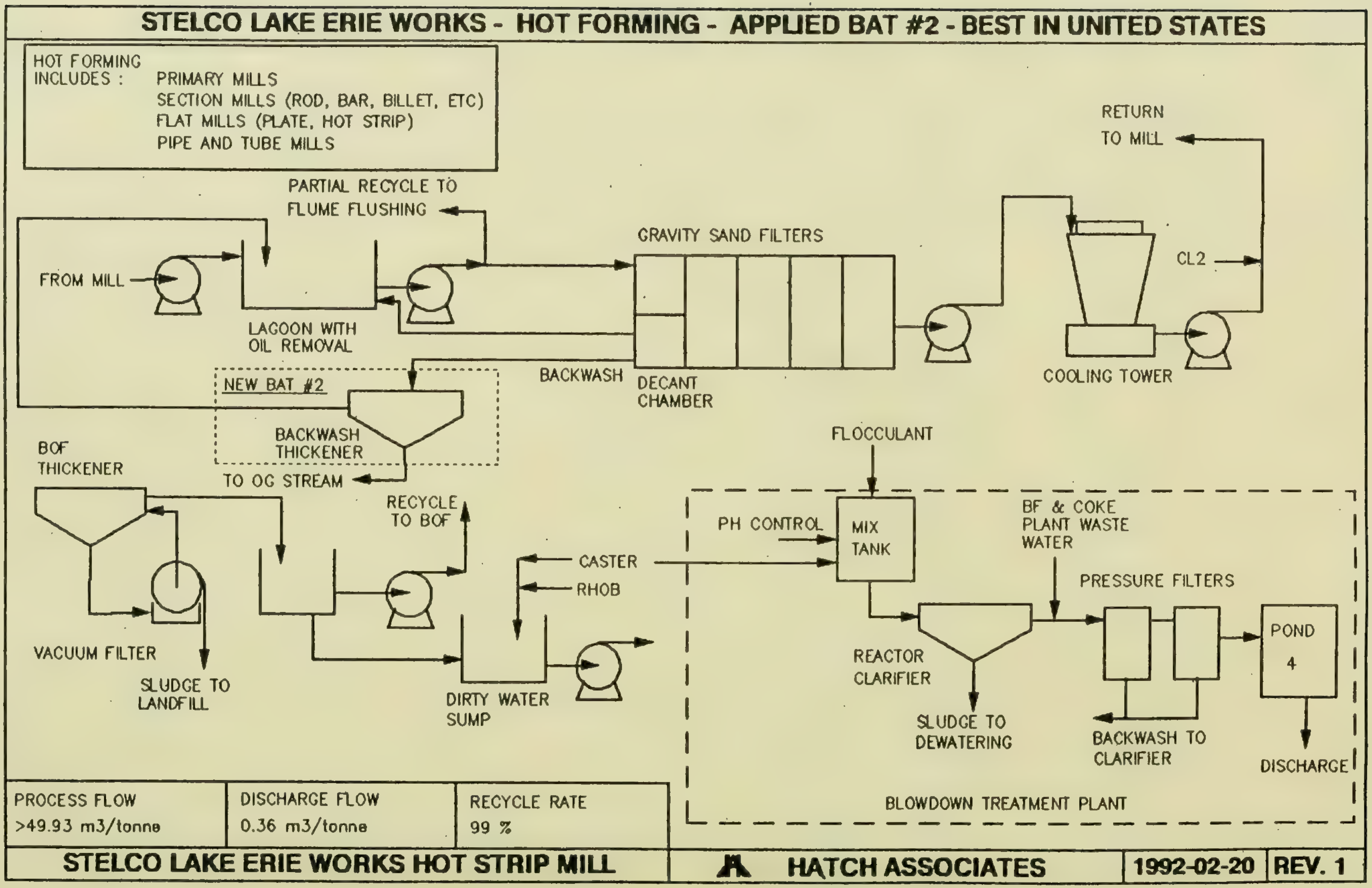

STELCO LAKE ERIE WORKS - HOT FORMING - APPLIED BAT #2 - BEST IN UNITED STATES
HOT FORMING INCLUDES : PRIMARY MILLS
SECTION MILLS (ROD, BAR, BILLET, ETC)
FLAT MILLS (PLATE, HOT STRIP)
PIPE AND TUBE MILLS
RETURN TO MILL
PARTIAL RECYCLE TO FLUME FLUSHING
FROM MILL
GRAVITY SAND FILTERS
CL2
LAGOON WITH OIL REMOVAL
BACKWASH
DECANT CHAMBER
COOLING TOWER
NEW BAT #2
BACKWASH THICKENER
BOF THICKENER
TO OG STREAM
FLOCCULANT
RECYCLE TO BOF
CASTER
RHOB
PH CONTROL
MIX TANK
BF & COKE PLANT WASTE WATER
PRESSURE FILTERS
POND 4
VACUUM FILTER
REACTOR CLARIFIER
SLUDGE TO LANDFILL
DIRTY WATER SUMP
SLUDGE TO DEWATERING
BACKWASH TO CLARIFIER
DISCHARGE
BLOWDOWN TREATMENT PLANT
PROCESS FLOW >49.93 m3/tonne
DISCHARGE FLOW 0.36 m3/tonne
RECYCLE RATE 99 %
STELCO LAKE ERIE WORKS HOT STRIP MILL
HATCH ASSOCIATES
1992-02-20
REV. 1

FIGURE 14.5.1

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – HOT FORMING – STELCO LEW

BAT	EXISTING		BAT #1	BAT #2		BAT #3	BAT #4	BAT #5
Flow (m3/day)	2863			1208				
Parameter	Average Conc. (mg/L)	Average Loading (kg/day)		Average Conc. (mg/L)	Average Loading (kg/day)			
TSS	* 4.9	14	See existing.	2.9	3.7	See BAT #2.	See BAT #2.	Not applicable.
oil and grease	6.3	18		7.1	7.7			

Notes: 1. Data calculated by disaggregation of loadings from MISA Monitoring Point 0400, based on Stelco LEW information.

* less than RMDL

TABLE 14.5.2 STELCO LAKE ERIE WORKS

HOT FORMING - APPLIED BAT 2 COSTING

FACILITY DESCRIPTION	EST. CAP. COST $MM	EST. TYPE
Piping From the New Thickener back to the HSM	0.60	B
Backwash Tank + Agitators + Pumps	0.84	C
TOTAL	**1.44**	

* Cost for HSM thickener is in Table 14.3.2. Steelmaking Applied BAT #2 Continuous Casting; this is not a stand-alone cost.

TABLE 14.5.3 : MISA MODEL / APPLIED BAT COSTING				
Mill : Stelco Steel, Lake Erie Works				
Subcategory : Hot Forming				
BAT : 2 – Filter Backwash tank + Piping From HSM to New Thickener				
Process Flow : 110 M3/HR				
Date: 92/03/10		Filename: LEWHFB2.WK1		
1. Capital Costs				
(a) Engineering and Design				$100,000
(b) Equipment				$379,000
(c) Installation				$394,000
(d) Facilities and Structure				$169,000
(e) Land				$0
(f) Other (Construction Expenses & Contingency)				$393,000
Total Capital Cost				$1,435,000
2. One Time Consulting or Service Expenses				
3. Operating and Maintenance Costs	Commodity	Quantities per year	Unit Costs	Annual Costs
(a) Energy Requirements	kWh	392100	$0.05	$20,000
Total Energy Requirements				$20,000
(b) Materials				
chemicals				$250,000
				$0
Total Materials				$250,000
(c) Operating Labour	Man years	1	$60,000	$60,000
(d) Maintenance	% of Capital	5.00%		$72,000
Total Operating and Maintenance				$402,000
4. Disposal of Sludges or Solid Wastes				
(a) Quantities Generated per Unit Time		No increase		
(b) Disposal Cost per Unit				
Comments:				

14.6 Integrated Mills Excluding Finishing

14.6.1 BAT #1 Best in Ontario

Stelco's Lake Erie Works Facility was selected as the BAT #1 technology for Integrated Mills Excluding Finishing. No modifications are required.

14.6.2 BAT #2 Best in the United States

In order to achieve a level of treatment equivalent to the Model BAT #2 categories, the water recycle rate for each system must be increased. In order to achieve the reduced blowdown rates, backwash thickeners are required for both the Continuous Casting and Hot Forming backwash streams. In addition, a CO_2 softening system is required to achieve a high recycle rate for the Steelmaking process water.

The predicted effluent quality data sheet, Table 14.6.1, for these modifications is attached. As discussed in Section 7.1, this table is presented for information purposes only. Model BAT #1, Stelco LEW, is based on an integrated mill with central treatment facilities but no finishing operations. Model BAT #2A is based on National Steel Granite City which is an integrated mill with central treatment facilities and finishing operations. The data was adjusted to represent a mill with no finishing operations by subtracting a fraction of the flow and pollutant loadings at National Steel, Midwest proportional to the Finishing production at the two mills. The Finishing operations at National Steel, Granite City and National Steel, Midwest are similar. Model BAT #2B is based on the sum of the flow and pollutant loading data for the Model BAT #2 in all categories. Model BAT #2C, LTV, Cleveland, is based on an integrated mill with no central treatment facilities.

14.6.3 BAT #3 Best at Selected World Locations

The BAT #1 treatment technology at Stelco Lake Erie Works was determined to be the best available Integrated Mill Excluding Finishing. No modifications to the treatment system are required.

14.6.4 BAT #4 Non-Lethal

The BAT #3 wastewater treatment technology for Integrated Mills Excluding Finishing was determined to be the BAT #1 process. No modifications to the treatment system are required.

The current final effluent at Stelco LEW passed the Ontario Toxicity Test ten out of twelve times for Daphnia Magna and twelve out of twelve times for Rainbow Trout during the MISA monitoring period.

14.6.5 BAT #5 Virtual Elimination of Persistent Toxics

The BAT #3 wastewater treatment technology for Integrated Mills Excluding Finishing was determined to be the BAT #1 process. No modifications to the treatment system are required.

As discussed in Volume I, virtual elimination of persistent toxics may have been achieved at Stelco LEW MISA point 400.

PREDICTED EFFLUENT QUALITY

INTEGRATED MILLS – EXCLUDING FINISHING – STELCO LAKE ERIE WORKS

BAT	EXISTING (Note 1)		BAT #1	BAT #2A (Note 2)		BAT #2B (Note 2)		BAT #2C (Note 2)		BAT #3	BAT #4	BAT #5
Flow (m3/day)	19607			29497		3835		3034				
Parameter	Average Conc. (mg/L)	Average Loading (kg/day)		Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)	Average Conc. (mg/L)	Average Loading (kg/day)			
TSS	• 4.9	96		5.7	169	19	72	18	54			
oil and grease	1.4	28	See	6.0	177	3.0	11	2.5	7.5	See	Note 3	Note 4
ammonia + ammonium	• 0.084	1.7	existing.	0.84	25	18	67	10	31	existing.		
cyanide total	0.11	2.2		0	0	1.6	6.2	2.9	8.8			
phenolics (4AAP)	0.0024	0.047		0.0041	0.12	0.033	0.13	0.079	0.24			
lead	0.031	0.63		0.0067	0.20	0.015	0.059	0.015	0.046			
zinc	0.063	1.3		0.041	1.2	0.066	0.25	0.25	0.75			
benzene	• 0.00023	0.0050		< 0.01	-	0.00066	0.0025	< DL	-			
benzo(a)pyrene	• 0.00050	0.010		< 0.01	-	0.0048	0.019	< DL	-			
naphthalene	• 0.00030	0.0060		< 0.01	-	0.0025	0.0097	< DL	-			
chromium	• 0.0090	0.18		-	-	-	-	-	-			
hexavalent chromium	-	-		-	-	-	-	-	-			

Notes:
1. Stelco LEW data direct from MISA Monitoring Point 0400. Stelco LEW does not have Sintering or Finishing operations.
2. Calculations are based on LEW steelmaking production during the MISA Monitoring Period.
3. Stelco LEW current final effluent passed the Ontario Toxicity Test ten out of twelve times for Daphnia Magna and twelve out of twelve times for Rainbow Trout during the MISA Monitoring Period.
4. No demonstrated technology in this industry sector.

• less than RMDL

1992-02-13	TABLE 14.6.1	HATCH ASSOCIATES	PEQCTLEW.WK1 PEQCTLEW.ALL	REV. # 3